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SECTION 01312

QUALITY CONTROL SYSTEM (QCS)

PART 1 GENERAL

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS-W) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS-Windows, referred to as QCS (QC for Quality Control), to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS-W and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320, "Project Schedule", Section 01330, SUBMITTAL PROCEDURES, and Section 01455, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1

U.S. Army Corps of Engineers Safety and
Health Requirement Manual

1.3 HARDWARE/SOFTWARE REQUIREMENTS

1.3.1 Installing the QCS Program

The QCSSetup<version>.exe is the program that you will begin the installation with. Launch the program through your Windows Explorer, the Run command, or however you are used to doing that sort of thing. This is self-extracting file and will create the necessary files and folders and complete the installation and set up your program. The window will close automatically when the extraction process is completed.

The program should install itself, asking only minimal questions. The program will tailor the installation to suit the computer it is being installed on. That is, the program will install a "new" program if one has not already been installed, it will install an "update" if the program is already installed on the computer and will determine each client or server requirement and automatically install/update what is required. Each screen and instruction is shown on the following pages.

1.4 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.5 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

IBM-compatible PC with 500 MHz Pentium or higher processor

128+ MB RAM for workstation / 256+ MB RAM for server.

1 GB hard drive disk space for sole use by the QCS system.

3-1/2 inch high-density floppy drive.

Compact Disk (CD) Reader 8x speed or higher.

SVGA or higher resolution monitor (1024x768, 256 colors).

Mouse or other pointing device.

Windows compatible printer. (Laser printer must have 4 MB+ of RAM).

Connection to the Internet, minimum 56k BPS

Software

MS Windows 98, ME, NT, or 2000.

Word Processing software compatible with MS Word 97 or newer.

Latest version of: Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher.

Electronic mail (E-mail) MAPI compatible.

Virus protection software that is regularly upgraded with all issued manufacturer's updates.

1.6 RELATED INFORMATION

1.6.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.6.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.7 CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.8 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM).

The QCS database typically shall include current data on the following items:

1.8.1 Administration

1.8.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.8.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.8.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.8.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.8.1.5 EM 385-1-1, Corps of Engineers Safety Manual and RMS Linkage

Upon request, the Contractor can obtain a copy of the current version of the Safety Manual, EM 385-1-1, on CD. Data on the CD will be accessible through QCS, or in stand-alone mode.

1.8.2 Finances

1.8.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by the Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract amount.

1.8.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.8.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01455, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.8.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01455, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.8.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.8.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.8.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.8.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.8.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.8.4 Submittal Management

When available, the Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns as described in Section 01330, SUBMITTAL PROCEDURES. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS-W will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.8.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Section 01320, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320 PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.8.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.9 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.10 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.10.1 File Medium

The Contractor shall submit required data on 3-1/2" double-sided high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.10.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, project name, project location, data date, name and telephone number of person responsible for the data.

1.10.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.11 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be

returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.12 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01320

PROJECT SCHEDULE

PART 1 GENERAL

1.1 ELECTRONIC SCHEDULE REQUIREMENT

The Project Schedule to be prepared by the Contractor shall be electronically prepared using software capable of generating a data file in the Standard Data Exchange Format (SDEF). The Project Schedule shall consist of a network analysis system as described below. In preparing this system the scheduling of Construction is the sole responsibility of the contractor. The requirement for the system is included to assure adequate planning in the execution of the work and to assist the Contracting Officer in appraising the reasonableness of the proposed schedule and evaluating progress of the work for the purposes of payment.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Project Schedule; G.
Initial Project Schedule; G.
Periodic Schedule Updates; G.

Two copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

Periodic schedule updates schedules shall be submitted together with the monthly progress payment request.

SD-06 Test Reports

Narrative Report.
Schedule Reports.

Two copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

SD-07 Certificates

Qualifications; G.

Documentation showing qualifications of personnel preparing schedule reports.

1.3 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports. This person shall have previously created and reviewed computerized schedules. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 ELECTRONIC PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manually generated schedules will not be accepted.

The system noted below is capable of generating a file in the Standard Data

Exchange Format (SDEF). All electronic data submittals shall be in SDEF. SDEF information is available from the Contracting Officer.

Vendor/System with SDEF support:

Primavera Systems PRIMAVERA PROJECT PLANNER (P3)

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

3.3.2 Level of Detail Required

With the exception of the preliminary schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

3.3.2.3 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

3.3.2.4 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not

limited to, the subcontracting firm, contractor work force, or government agency performing a given task. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.5 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.6 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number.

3.3.2.7 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.8 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice-to-proceed to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date that the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in

the project schedule an activity called "End Project". The "End Project" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity and ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contracting Officer may direct that changes in schedule logic be made to correct any or all out-of-sequence work.

3.3.7 Extended Non-Work Periods

Designation of Holidays to account for non-work periods of over 5 days will not be allowed. Non-work periods of over 5 days shall be identified by addition of activities that represent the delays. Modifications to the logic of the project schedule shall be made to link those activities that may have been impacted by the delays to the newly added delay activities.

3.3.8 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days shall be submitted for approval within 20 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 90 calendar days after Notice to Proceed.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 60 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall submit, with the Initial Project Schedule, a coding scheme that shall be used throughout the project for all activity codes contained in the schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, a Responsibility Code Value, "ELE", may be identified as "Electrical Subcontractor." Activity code values shall represent the same information throughout the duration of the contract. Once accepted with the Initial Project Schedule submission, changes to the activity coding scheme must be accepted by the Contracting Officer.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the initial submission, and every periodic project schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks or two sets of data disks containing the project schedule shall be provided. Data on the disks shall be in the Standard Data Exchange Format (SDEF), in accordance with ER-1-1-11, PROGRESS, SCHEDULES, AND NETWORK ANALYSIS SYSTEMS, Appendix A, Standard Data Exchange Format Specification (attached at the end of this Project Schedule specification.

3.5.1.1 File Medium

Required data shall be submitted on 3.5-inch disks, formatted to hold 1.44 MB of data, under the MS-Windows operating system.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the operating system and version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the critical path(s), a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.

3.5.4.3 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: Activity Number or "i-node" and "j-node", Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

A graph of anticipated earnings (S-Curves) showing cumulative earnings for the duration of the project. The vertical scale shall show earnings/percent complete from 0%-100%. The horizontal scale shall be a time scale showing the calendar months of the project. Three curves shall be plotted on the same graph; the earnings/percent complete based on early finish dates; the earnings/percent complete based on late finish dates; the actual earnings/percent complete to date.

3.5.5.6 Bar Chart

A bar chart covering the previous month's activities and progress, and the planned activities over 3 months projected into the future. The chart shall also include actual and anticipated earnings.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. The following is a minimum set of items which the Contractor shall address, on an activity by activity basis, during each

progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed activities.

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary, and 3) a schedule which does not represent the actual prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, he shall furnish such justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request.

The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in

effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

STANDARD DATA EXCHANGE FORMAT SPECIFICATION**PART 1- GENERAL**

1. Application of This Provision: The Standard Data Exchange Format (SDEF) provides a nonproprietary protocol to exchange project planning and progress data between scheduling systems.

2. File Type and Format: The data file shall consist of a 132 character, freed format, "ASCII" file. Text shall be left-justified and numbers shall be right-justified in each field. Data records must conform, exactly, to the sequence, column position, maximum length, mandatory values, and field definitions described below to comply with the SDEF. Unless specifically stated, all numbers shall be whole numbers. Fields containing numbers shall not be zero filled. All data columns shall be separated by a single blank column. The file shall not contain blank lines.

3. Usage Notes: Where appropriate, notes regarding proper usage of systems to support the SDEF have been included in brackets ([]). These notes are included to assist users in creating SDEFcompatible files, given the variety of software systems that support the SDEF.

4. Recommended Systems: Several systems have been tested to determine the accuracy of importing and exporting SDEF files. For information on the current list of recommended systems please contact Mr. Brad James at HQUSACE, (202) 761-5541. Although the currently listed system have been tested other systems may also be acceptable provided those systems correctly import and export SDEF files.

5. SDEF Checker Program: To verify SDEF files meet the specified guidelines download the SDEF Checker utility from the winrms website. Go to <http://winrms.usace.army.mil>, click on the **User Manuals** Link to the left and then click on the **P3 SDEF** Link to the left.

PART 2- SDEF SPECIFICATION

6. SDEF Organization: The SDEF shall consist of the following records provided in the exact sequence shown below:

* Change in POC information.

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Paragraph Record

<u>Reference</u>	<u>Description</u>	<u>Remarks</u>
6.a	Volume Record	Mandatory First Line of File
6.b	Project Record	Mandatory Second Line of File
6.c	Calendar Record(s)	Mandatory One Record Minimum
6.d	Holiday Record(s)	Mandatory if Holidays Used
6.e	Activity Record(s)	Mandatory Records
6.f	Precedence Record(s)	Mandatory for Precedence
6.g	Unit Cost Record(s)	Mandatory for Unit Costs
6.h	Progress Record(s)	Mandatory Records
6.i	File End Record	Mandatory Last Line of Disk/File

6.a. Volume Record: The Volume Record shall be used to control the transfer of data that may not fit on a single disk. The first line in every file used to store SDEF data shall be the Volume Record. The Volume Record shall sequentially identify the number of the data transfer disk(s). The Volume Record shall have the following format:

<u>Description</u>	<u>Column</u>	<u>Max.</u>	<u>Req.</u>	<u>Type</u>	<u>Notes</u>
	<u>Position</u>	<u>Len.</u>	<u>Value</u>		
RECORD IDENTIFIER	1 - 4	4	VOLM	Fixed	Filled
DISK NUMBER	6 - 7	2	√	Number	Right Justified

6.a.(1) The RECORD IDENTIFIER is the first four characters of this record. The required value for this field shall be "VOLM". The VOLM record must appear on the first line of the SDEF data file.

6.a.(2) The DISK NUMBER field shall identify the number of the data disk used to store the data exchange information. If all data may be contained on a single disk, this field shall contain the value of "1". If more disks are required, then the second disk shall contain the value "2", the third disk shall be designated with a "3", and so on. Identification of the last data disk is accomplished in the Reject End Record.

6.b. Project Record: The Project Identifier Record shall contain general project information. Because more than one SDEF file may be required for data transfer between large projects, the PROJ record shall be the second line of the first SDEF file transferred. The PROJ record shall contain information in the following format:

<u>Description</u>	<u>Column Position</u>	<u>Max. Len.</u>	<u>Req. Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1- 4	4	PROJ	Fixed	Filled
DATA DATE	6- 12	7	√	ddmmyy	Filled
PROJECT IDENTIFIER	14-17	4	√	Alpha.	Left Justified
PROJECT NAME	19-66	48	√	Alpha.	Left Justified
CONTRACTOR NAME	68-103	36	√	Alpha.	Left Justified
ARROW OR PRECEDENCE	105-105	1	A,P	Fixed	Filled
CONTRACT NUMBER	107-112	6	√	Alpha.	Left Justified
PROJECT START	114-120	7	√	ddmmyy	Filled
PROJECT END	122-128	7	√	ddmmyy	Filled

6.b.(1) The RECORD IDENTIFIER is the first four characters of this record. The required value for this field shall be "PROJ". This record shall contain the general project information and indicates which scheduling method shall be used.

6.b.(2) The DATA DATE is the date of the schedule calculation. The abbreviation "ddmmyy" refers to a date format that shall translate a date into two numbers for the day, three letters for the month, and two numbers for the year. For example, March 1, 1999 shall be translated into 01Mar99. This same convention for date formats shall be used throughout the entire data format. To ensure that dates are translated consistently, the following abbreviations shall be used for the three character month code:

Abbreviation Month

JAN	January
FEB	February
MAR	March
APR	April
MAY	May
JUN	June
JUL	July
AUG	August
SEP	September
OCT	October
NOV	November
DEC	December

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6.b.(3) The PROJECT IDENTIFIER is a maximum four character abbreviation for the schedule. These four characters shall be used to uniquely identify the project and specific update as agreed upon by Contractor and Contracting Officer. When utilizing scheduling software these four characters shall be used to select the project. Software manufacturers shall provide information to users to ensure that data importing programs do not automatically overwrite other schedules with the same PROJECT IDENTIFIER.

6.b.(4) The PROJECT NAME field shall contain the name and location of the project edited to fit the space provided. The data appearing here shall appear on scheduling software reports. The abbreviation "Alpha." refers to an "Alphanumeric" field value and shall be used throughout the remainder of this specification.

6.b.(5) The CONTRACTOR NAME field shall contain the Construction Contractor's name, edited to fit the space provided.

6.b.(6) The ARROW OR PRECEDENCE field shall indicate which method shall be used for calculation of the schedule. The value "A" shall signify the Arrow Diagramming Method. The value "P" shall signify the Precedence Diagramming Method. The ACTIVITY ID field of the Activity Record shall be interpreted differently depending on the value of this field. The Precedence Record shall be required if the value of this field is "P". [Usage note: software systems may not support both arrow and precedence diagramming. It is recommended that the selection of the type of network be based on the capabilities of the software used by project partners.]

6.b.(7) The CONTRACT NUMBER field shall contain the contract number for the project. For example, the construction contract number DACA85-89-C-0001 shall be entered into this field as "890001".

6.b.(8) The PROJECT START field shall contain the date that the Contractor acknowledges the Notice to Proceed (NTP). [Usage note: Software systems may use a project start date to constrain the first activity of a network. To ensure consistent scheduling calculations across products, it is recommended that the first activity in the schedule contain an EARLY START constraint and a software system's PROJECT START date only be used to report on the project's start date.]

6.b.(9) The PROJECT END field shall contain the date that the Contractor plans to complete the work as approved by the Contracting Officer. [Usage note: software systems may use a project end date to constrain the last activity of a network. To ensure consistent scheduling calculations across products, it is recommended that the last activity in the schedule contain an EARLY START constraint and a software system's PROJECT END date only be used to report on the project's end date.]

6.c. Calendar Record: The Calendar Record(s) shall follow the Project Identifier Record in the first disk of data transferred. A minimum of one Calendar Record shall be required for all data exchange activity files. The format for the Calendar Record shall be as follows:

<u>Description</u>	<u>Column Position</u>	<u>Max. Len.</u>	<u>Req. Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1 - 4	4	CLDR	Fixed	Filled
CALENDAR CODE	6 - 6	1	√	Alpha.	Filled
WORKDAYS	8 - 14	7	SMTWTFS	Fixed	Filled
CALENDAR DESCRIPTION	16-45	30	√	Alpha.	Left Justified

6.c.(1) The RECORD IDENTIFIER shall always begin with "CLDR" to identify it as a Calendar Record. Each Calendar Record used shall have this identification in the first four columns. [Usage note: Systems contain a variety of calendar options. It is recommended that the least common denominator of calendar features between the systems be used as the basis for creating the SDEF file for a given project.]

6.c.(2) The CALENDAR CODE shall be used in the activity records to signify that this calendar is associated with the activity. [Usage note: Some systems do not allow for alphanumeric CALENDAR CODES, but only allow positive integers from 1 to 9. It is recommended that only positive integers be used for the CALENDAR CODE field to support the widest variety of scheduling systems.]

6.c.(3) The WORKDAYS field shall contain the work-week pattern selected with "Y", for Yes, and "N", for No. The first character shall be Sunday and the last character Saturday. An example of a typical five (5) day work-week would be NYYYYYN. A seven (7) day work-week would be YYYYYYY.

6.c.(4) The CALENDAR DESCRIPTION shall be used to briefly describe the calendar used.

6.d. Holiday Record: The Holiday Record(s) shall follow the Calendar Record(s) in the first disk of data transferred. There may be calendars without any holidays designated or several Holiday Records for each Calendar Record(s). The format for the Holiday Record shall be as follows:

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<u>Description</u>	<u>Column Position</u>	<u>Max. Len.</u>	<u>Req. Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1 - 4	4	HOLI	Fixed	Filled
CALENDAR CODE	6 - 6	1	√	Alpha.	Filled
HOLIDAY DATE	8 - 14	7	√	ddmmyy	Filled
HOLIDAY DATE	16-22	7	-	ddmmyy	May be Filled
HOLIDAY DATE	24-30	7	-	ddmmyy	May be Filled
HOLIDAY DATE	32-38	7	-	ddmmyy	May be Filled
HOLIDAY DATE	40-46	7	-	ddmmyy	May be Filled
HOLIDAY DATE	48-54	7	-	ddmmyy	May be Filled
HOLIDAY DATE	56-62	7	-	ddmmyy	May be Filled
HOLIDAY DATE	64-70	7	-	ddmmyy	May be Filled
HOLIDAY DATE	72-78	7	-	ddmmyy	May be Filled
HOLIDAY DATE	80-86	7	-	ddmmyy	May be Filled
HOLIDAY DATE	88-94	7	-	ddmmyy	May be Filled
HOLIDAY DATE	96-102	7	-	ddmmyy	May be Filled
HOLIDAY DATE	104-110	7	-	ddmmyy	May be Filled
HOLIDAY DATE	112-118	7	-	ddmmyy	May be Filled
HOLIDAY DATE	120-126	7	-	ddmmyy	May be Filled

6.d.(1) The RECORD IDENTIFIER shall always begin with "HOLI". Each Holiday Record used shall have this identification in the first four columns.

6.d.(2) The CALENDAR CODE indicates which work-week calendar the holidays shall be applied to. More than one HOLI record may be used for a given CALENDAR CODE.

6.d.(3) The HOLIDAY DATE shall contain the date of each individual non-work day.

6.e. Activity Records: Activity Records shall follow any Holiday Record(s). If there are no Holiday Record(s), then the Activity Records shall follow the Calendar Record(s). There shall be one Activity Record for every activity in the network. Each activity shall have one record in the following format:

<u>Description</u>	<u>Column Position</u>	<u>Max. Len.</u>	<u>Req. Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1 - 4	4	ACTV	Fixed	Filled
ACTIVITY ID	6 - 15	10	√	Integer	See Comment Below
ACTIVITY DESCR.	17-46	30	√	Alpha.	Left Justified
ACTIVITY DURATION	48-50	3	√	Integer	Right Justified
CONSTRAINT DATE	52-58	7		ddmmmyy	May be Filled
CONSTRAINT TYPE	60-61	2		ES or LF	May be Filled
CALENDAR CODE	63-63	1	√	Alpha.	Filled
HAMMOCK CODE	65-65	1	Y, blank	Fixed	May be Filled
WORKERS PER DAY	67-69	3		Integer	Right Justified
RESPONSIBILITY CODE	71-74	4		Alpha.	Left Justified
WORK AREA CODE	76-79	4		Alpha.	Left Justified
MOD OR CLAIM NO.	81-86	6		Alpha.	Left Justified
BID ITEM	88-93	6		Alpha.	Left Justified
PHASE OF WORK	95-96	2		Alpha.	Left Justified
CATEGORY OF WORK	98-98	1		Alpha.	May be Filled
FEATURE OF WORK	100-128	30		Alpha.	Left Justified

6.e.(1) The RECORD IDENTIFIER for each activity description record must begin with the four character "ACTV" code. This field shall be used for both the Arrow Diagram Method (ADM) and Precedence Diagram Method (PDM),

6.e.(2) The ACTIVITY ID consists of coding that shall differ, depending on whether the ADM or PDM method was selected in the Project Record. If the ADM method was selected then the field shall be interpreted as two right-justified fields of five (5) integers each. If the PDM method was selected the field shall be interpreted as one (1) right-justified field of ten (10) integers each. The maximum activity number allowed under this arrangement is 99999 for ADM and 999999999 for the PDM method. [Usage note: Many systems allow alphanumeric ACTIVITY IDs. While the SDEF does not strictly, allow the use of alphanumeric values, users may agree to use the ACTIVITY ID field to exchange alphanumeric data. It is recommended that the ACTIVITY ID be restricted to integers when one or more of the systems being used for scheduling allows only integer ACTIVITY ID values.]

6.e.(3) The ACTIVITY DESCRIPTION shall be a maximum of 30 characters. Descriptions must be limited to the space provided.

6.e.(4) The ACTIVITY DURATION contains the estimated original duration for the activity on the schedule. The duration shall be based upon the work-week designated by the activity's related calendar.

6.e.(5) The CONSTRAINT DATE field shall be used to identify a date that the scheduling system may use to modify float calculations. If there is a date in this field, then there must be a valid entry in the CONSTRAINT TYPE field.

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6.e.(6) The CONSTRAINT TYPE field shall be used to identify the way that the scheduling system shall use the CONSTRAINT DATE to modify schedule float calculations. If there is a value in this field, then there must be a valid entry in the CONSTRAINT DATE field. The valid values for the CONSTRAINT TYPE are as follows:

<u>Code</u>	<u>Definition</u>
ES	The CONSTRAINT DATE shall replace an activity's early start date, if the early start date is prior to the CONSTRAINT DATE.
LF	The CONSTRAINT DATE shall replace an activity's late finish date, if the late finish date is after the CONSTRAINT DATE.

[Usage note: Systems provide a wide variety of constraint types that may not be supported by other systems. It is recommended that constraint types be restricted to the values above regardless of the capabilities of the various systems being used for scheduling.]

6.e.(7) The CALENDAR CODE relates this activity to an appropriate work-week calendar. The ACTIVITY DURATION must be based on the valid work-week referenced by this CALENDAR CODE field.

6.e.(8) The HAMMOCK CODE indicates that a particular activity does not have its own independent duration, but takes its start dates from the start date of the preceding activity (or node) and takes its finish dates from the finish dates of its succeeding activity (or node). If the value of the HAMMOCK CODE field is "Y", then the activity is a hammock activity.

6.e.(9) The WORKERS PER DAY shall contain the average number of workers expected to work on the activity each day the activity is in progress. If this code is required by project scheduling specifications, values for this data will be right justified. Activities without workers per day shall have a value of "0".

6.e.(10) The RESPONSIBILITY CODE shall identify the subcontractors or major trade involved with completing the work for the activity. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(11) The WORK AREA CODE shall identify the location of the activity within the project. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(12) The MOD OR CLAIM NUMBER shall uniquely identify activities that are added or changed on a construction contract modification, or activities that justify any claimed time extensions. If this code is required by project scheduling specifications, value for this data will be left justified.

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6.e.(13) The BID ITEM shall identify the bid item number associated with each activity. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(14) The PHASE OF WORK shall identify the timing of a specific activity within the entire project. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(15) The CATEGORY OF WORK shall identify the general type of work performed by every activity. If this code is required by project scheduling specifications, value for this data will be placed in the field.

6.e.(16) The FEATURE OF WORK shall identify a very broad designation of the general type of work that is being accomplished by the activity. If this code is required by project scheduling specifications, value for this data will be left justified. [Usage note: Many systems require that FEATURE OF WORK values be placed in several activity code fields. It is recommended that users review SDEF documentation to determine the correct way to use a given software system to produce the FEATURE OF WORK code.]

6.f. Precedence Record: The Precedence Record(s) shall follow the Activity Records if a Precedence Diagram Method schedule (PDM) is identified in the ARROW OR PRECEDENCE field of the Project Record. The Precedence Record has the following format:

<u>Description</u>	<u>Column</u>	<u>Max.</u>	<u>Req.</u>	<u>Type</u>	<u>Notes</u>
	<u>Position</u>	<u>Len.</u>	<u>Value</u>		
RECORD IDENTIFIER	1 - 4	4	PRED	Fixed	Filled
ACTIVITY ID	6-15	10	√	Integer	See Comment Below
PRECEDING ACTIVITY	17 -26	10	√	Integer	See Comment Below
PREDECESSOR TYPE	28-28	1	√	S, F, C	Filled
LAG DURATION	30-33	4	√	Integer	Right Justified

6.f.(1) The RECORD IDENTIFIER shall begin with the four characters "PRED" in the first four columns of the record.

6.f.(2) The ACTIVITY ID identifies the activity whose predecessor shall be specified in this record.

6.f.(3) The PRECEDING ACTIVITY number is the number of an activity that precedes the activity noted in the ACTIVITY ID field.

6.f.(4) The PREDECESSOR TYPE field indicates the type of relation that exists between the chosen pair of activities. Valid PREDECESSOR TYPE fields areas follows:

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<u>Code</u>	<u>Definition</u>
S	Start-to-Start relation
F	Finish-to-Finish relation
C	Finish-to-Start relation

[Usage note: Some systems provide additional predecessor types that may not be supported by all other systems. It is recommended that predecessor types be restricted to the values above regardless of the capabilities of the various systems being used for scheduling.]

6.f.(5) The LAG DURATION field contains the number of days delay between the preceding and current activity. [Usage note: Some systems allow negative values for the LAG DURATION. Because these values are not supported by all other systems, it is recommended that values be restricted to zero and positive integers.]

6.g. Unit Cost Record: The Unit Cost Record shall follow all Precedence Records. If the schedule utilizes the Arrow Diagram Method, then the Unit Cost Record shall follow any Activity records. There shall be one Unit Cost Record for every activity that is not a lump sum activity. [Usage note: (1) It is recommended that users who wish to exchange unit cost data contact SDEF vendor representatives to determine the ability of the software system to import/export unit cost information. (2) If the software being used by each member of the project team supports unit cost data then users may wish to conduct a trial run of the SDEF data exchange with a two or three-activity network to ensure that unit cost data transfers as expected. If problems are found please consult vendor representatives for resolution prior to exchange of full project schedules. (3) Unit cost record data does not, in most systems, result in the correct values being placed in the ACTIVITY COST and COST TO DATE fields of the Progress (PROG) Record. Users must, at this time, manually transfer the data from the Unit Cost Record to the Progress Record.

The fields for this record shall take the following format:

<u>Description</u>	<u>Column Position</u>	<u>Max. Len.</u>	<u>Req. Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1 - 4	4	UNIT	Fixed	Filled
ACTIVITY ID	6-15	10	√	Integer	See Comment Below
TOTAL QTY	17-29	13	√	Format 8.4	Right Justified
COST PER UNIT	31-43	13	√	Format 8.4	Right Justified
QTY TO DATE	45-57	13	√	Format 8.4	Right Justified
UNIT OF MEASURE	59-61	3	√	Alpha.	Left Justified

6.g.(1) The RECORD IDENTIFIER shall be identified with the four characters "UNIT" placed in the first four columns of the record.

6.g.(2) The ACTIVITY ID for each activity shall match the format described in the activity record. Each activity may have only one Unit Cost Record.

6.g.(3) The TOTAL QTY is the total amount of material to be used in this activity. This number consists of eight digits, one decimal point and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 25-29. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(4) The COST PER UNIT is the cost, in dollars and cents, for each unit to be used in this activity. This number consists of eight digits, one decimal point, and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 39-43. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(5) The QTY TO DATE is the quantity of material installed in this activity up to the data date. This number consists of eight digits, one decimal point, and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 53-57. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(6) The UNIT OF MEASURE is an abbreviation that may be used to describe the units being measured for this activity. Valid values for this field are any meaningful English or metric unit, except "LS" for Lump Sum. Lump Sum activities are not to have Unit Cost Records.

6.h. Progress Record: Progress Record(s) shall follow all Unit Cost Record(s). If there are no Unit Cost Record(s), then the Progress Record(s) shall follow all Precedence Records. If the schedule utilizes the Arrow Diagram Method, then the Progress Record shall follow any Activity Records. One Progress Record is required for every activity in the Activity Record. The fields for this Record shall be provided in the following format:

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<u>Description</u>	<u>Column</u> <u>Position</u>	<u>Max.</u> <u>Len.</u>	<u>Req.</u> <u>Value</u>	<u>Type</u>	<u>Notes</u>
RECORD IDENTIFIER	1-4	4	PROG	Fixed	Filled
ACTIVITY ID	6-5	10	√	Integer	See Comment Below
ACTUAL START DATE	17-23	7	√	ddmmyy	Filled if Started
ACTUAL FINISH DATE	25-31	7	√	ddmmyy	Filled if Finished
REMAINING DURATION	33-35	3	√	Integer	Right Justified
ACTIVITY COST	37-48	12	√	Format 9.2	Right Justified
COST TO DATE	50-61	12	√	Format 9.2	Right Justified
STORED MATERIAL	63-74	12	√	Format 9.2	Right Justified
EARLY START DATE	76-82	7	√	ddmmyy	Filled if Not Started
EARLY FINISH DATE	84-90	7	√	ddmmyy	Filled if Not Finished
LATE START DATE	92-98	7	√	ddmmyy	Filled if Not Started
LATE FINISH DATE	100-1067		√	ddmmyy	Filled if Not Finished
FLOAT SIGN	108-1081		+,-	Fixed	Filled if Not Finished
TOTAL FLOAT	110-1123		√	Integer	R. Just. if Not Finished

6.h.(1) The RECORD IDENTIFIER shall begin with the four characters "PROG" in the first four columns of the record.

6.h.(2) The ACTIVITY ID for each activity for which progress has been posted shall match the format described in the Activity Record.

6.h.(3) An ACTUAL START DATE is required for all in-progress activities. The ACTUAL START DATE shall be the same as, or later than, the PROJECT START date contained in the Project Record. The ACTUAL START DATE shall also be the same as, or prior to, the DATA DATE contained in the Project Record. If there is an ACTUAL START DATE for an activity that there must also be a REMAINING DURATION, and the values for the EARLY START DATE and LATE START DATE are blank. [Usage note: Some systems allow default values for ACTUAL START DATE if the date is not entered by the user. Because the failure to include a start date for activities may result in different schedule calculations, it is recommended that the ACTUAL START DATE be required for all activities in progress.]

6.h.(4) An ACTUAL FINISH DATE is required for all completed activities. If the REMAINING DURATION of an activity is zero, then there must be an ACTUAL FINISH DATE. If there is an ACTUAL FINISH DATE, then values for the EARLY START DATE, LATE START DATE, EARLY FINISH DATE, LATE FINISH DATE, FLOAT SIGN, and TOTAL FLOAT shall be blank. [Usage note: Some systems allow default values for ACTUAL FINISH DATE if the date is not entered by the user. Because the failure to include a finish date for activities may result in different schedule calculations, it is recommended that the ACTUAL FINISH DATE be required for all activities in progress.]

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6.h.(5) REMAINING DURATION is required for all activities. Activities that have not started shall have a remaining duration equal to their original duration. Activities completed based on time, shall have a zero (0) REMAINING DURATION. [Usage note: Systems have a variety of "short-cut" methods to determine the REMAINING DURATION value. It is recommended that users actually consider the time required to complete the remaining work on a given task, rather than allow a system to calculate the remaining duration based on the amount of work that has already been accomplished.]

6.h.(6) The ACTIVITY COST contains the estimated earned value of the work to be accomplished in the activity. An example of a number in this format is "1111111 11.11". If decimal places are not needed this field shall still contain a ".00" in the last three columns of this field. [Usage note: Users should inquire of software vendors if the user needs to add a zero in the data field to produce the default value "0.00".]

6.h.(7) The COST TO DATE contains the earned value for the activity. If there is an ACTUAL START DATE, then there must also be some value for COST TO DATE. An example of a number in this format is "11111111.11". If decimal places are not needed, this field shall still contain a ".00" in the last three columns of this field. The COST TO DATE is not tied to REMAINING DURATION. For example, if the REMAINING DURATION is "0", the COST TO DATE may only be 95% of the ACTIVITY COST. This difference may be used to reflect 5% retainage for punch list items. [Usage note: Systems implement cost information in different ways. It is recommended that users carefully review SDEF documentation and test results to determine how to ensure that SDEF data is exported correctly.]

6.h.(8) The STORED MATERIAL field contains the value of the material that the Contractor has paid for and is on site or in secure storage areas that is a portion of the COST TO DATE. An example of a number in this format is "11111111.11". If decimal places are not needed, this field shall still contain a ".00" in the last three columns of this field. [Usage note: Systems implement the stored materials field in a variety of ways. Many systems do not enforce STORED MATERIAL + COST TO DATE < ACTIVITY COST. To avoid potential confusion between systems, it is recommended that new activities be added to a schedule to reflect the cost of large equipment procurement rather than use the STORED MATERIALS field.]

6.h.(9) The EARLY START DATE indicates the earliest date possible that an activity can start as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL START DATE, then this field shall be blank.

6.h.(10) The EARLY FINISH DATE indicates the earliest date possible that an activity can finish as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank.

6.h.(11) The LATE START DATE indicates the latest date that an activity can begin as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL START DATE, then this field shall be blank.

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6.h.(12) The LATE FINISH DATE indicates the latest date that an activity can finish as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank.

6.h.(13) The FLOAT SIGN indicates whether the float time calculated using a CPM scheduling system or other Contracting Officer approved planning method, is positive or negative in nature. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank. In the case of zero float this field shall be blank.

6.h.(14) The TOTAL FLOAT indicates the total float time. In the Precedence Diagram Method (PDM), the total float is the difference between the early and late start or finish dates. In the Arrow Diagram Method (ADM), the total float is equal to the late event time at the end of the activity, minus the sum of the early event time at the start of the activity plus the duration of the activity.

6.i. Project End Record: The Project End Record shall be used to identify that the data file is completed. If the ASCII End of File character is encountered, then data import programs shall use that character to infer that the data continues on the next disk. The user shall then be prompted for the next disk number, based on the VOLM record data. The Project End Record shall be the last record of the entire data file, and shall have the following format:

<u>Description</u>	<u>Column</u>	<u>Max.</u>	<u>Req.</u>	<u>Type</u>	<u>Notes</u>
	<u>Position</u>	<u>Len.</u>	<u>Value</u>		
RECORD IDENTIFIER	1-3	3	END	Fixed	Filled

6.i.(1) The RECORD IDENTIFIER for the Project End Record shall be "END". Data contained in the data exchange file that occurs after this record shall not be used.

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SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL DESCRIPTION

The submittals described below are those required and further described in other sections of the specifications. Other requirements pertaining to submittals are included in the SPECIAL CLAUSES. Submittals required by the CONTRACT CLAUSES and other nontechnical parts of the contract are not included in this section.

SD-01 Preconstruction Submittals

Project Schedule.
Submittal Register.
Safety Plan.
Construction Quality Control Plan.
Environmental Control Plan.
Waste Management Plan.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.
Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.
Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of materials or product and establish standards by which the work can be judged.
Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site to establish standards by which the ensuing work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at the conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses and other data pertaining to a part of the work.

SD-06 Test Reports

Report signed by an authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with the specified requirements. (Testing must have been within three years of date of contract award for the project, unless otherwise specified.)

Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project before shipment to the job site.

Report which includes findings of a test made at the job site or on a sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Final testing and acceptance reports.

SD-07 Certificates

Statements signed by a responsible official of the company that manufactured a product, system or material attesting that product, system or material meets the specified requirements. Must be dated after award of the project contract, clearly name the project and identify the product, system or material being certified, including the specified required being met.

Documentation required of the Contractor, or of a supplier, installer or subcontractor through the contractor, the purpose of which is to verify the orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including, but not limited to, special notices, Material Safety Data Sheets (MSDS) concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by the manufacturer's representative to confirm compliance with the manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

As-built drawings.

As-built record of equipment and materials.

Final Approved Shop Drawings.

Real Property Equipment List.

Warranty Management Plan.

Warranty Tags.

Mechanical Testing, Adjusting, Balancing, and Commissioning Report.

Operation and Maintenance Manuals.

Final Clean-up List.

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contractor shall coordinate Governmental approval submittals with all other aspects of the project so that proper interfaces are maintained. The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is a copy of the submittal register listing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required. The Contractor shall use the government-provided software, QCS (see Section 01312), to create the ENG Form 4288. The contractor is responsible for completing the columns labeled: Activity Number, Transmittal Number, and Contract Schedule Dates on the submittal register form. A copy of the form with the required contract submittals is furnished to the Contractor at the end of this section. The completed Submittal Register shall be submitted to the Contracting Officer for approval within 14 calendar days after Notice to Proceed. The submit dates and need dates in the submittal register shall

be coordinated with the dates in the Contractor's progress schedule. Updates to the submittal register showing the Contractor action codes and actual submittal dates with Government action codes and action dates shall be submitted monthly together with the monthly payment request, or until all submittals have been satisfactorily completed. When the progress schedule is revised, the submittal register shall also be revised and both resubmitted for approval. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 15 calendar days shall be allowed and shown on the register for review and approval of submittals for food service equipment and refrigeration and HVAC control systems.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

3.4.1 USE

A transmittal form (ENG Form 4025) shall be used for submitting both Government approved and information only submittals. The Contractor shall use the government-provided software, QCS (see Section 01312), to create the ENG Form 4025. Filling out all the heading blank spaces and identifying each item submitted shall properly complete this form. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.4.2 NUMBERING

Transmittals shall be numbered, as provided by CQS/RMS.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Procedures

The Contractor shall establish procedures for purchasing materials and equipment, subcontracting, and processing of shop drawings, outlining the responsibilities at each level to insure that adequate review and approval, timely delivery, verification of procedures and proper storage are provided. Delays in the review and approval process shall not be given consideration for a time extension or additional cost, when such delays are the result of the Contractor's late submittal or failure to provide proper submittals; or make corrections in compliance with the contract documents or the Contracting Officer's comments; or provide a resubmittal because of

an unacceptable original submittal.

3.5.2 Deviations

a. For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. Approval action by the Contracting Officer will not relieve the Contractor of his quality control responsibility and compliance with the contract, except for those specific portions of a submittal which clearly highlight the departures from the contract, and which are brought to the attention of the Government. The Contractor shall be responsible for all corrective actions, when submittals containing provisions of non-compliance with the contract are not specifically brought to the Government's attention.

Any associated cost or time loss resulting from such corrective actions shall not be made subject to a claim against the Government. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

b. In cases where "trade names or equal" specifications are used in the Technical Specifications, any "equal" substitution by the Contractor is considered a variance and will require the Government's approval. The submittal shall specifically indicate if the "equal" does not conform to features of the "trade name" along with justification for the difference.

c. Variations from the contract requirements may require an appropriate contract modification prior to acceptance by the Government; however, such pending action shall not be a basis of claim for time or additional cost against the Government, since the Contractor still has the option to comply with the original contract requirements. If the variation is of a minor nature and does not affect a change in cost or time of performance, a modification may not be issued. All variations shall meet the standards set by the contract documents.

3.6 COORDINATION OF LAYOUTS

The Contractor Quality Control (CQC) organization is responsible for ensuring that the shop drawings and submittals of the different trades are coordinated in order that space conflicts during installation/construction of mechanical, electrical, architectural, civil, structural and other items of work are avoided. The Contractor shall prepare/develop coordinated working layout drawings prior to commencement of any feature of work, at any contractor tier, unless otherwise directed by the Contracting Officer. These layout drawings shall be reviewed and certified by the CQC organization prior to the start of work in any area. The CQC shall ensure that layout drawings indicate all necessary features of work, providing for a coordinated arrangement of the various installations, giving full consideration for access to installed equipment/systems and the future maintenance of these items. Interference between equipment and systems or construction materials which cannot be resolved between Contractor and

subcontracting tiers shall be resolved by the Contracting Officer at no additional cost to the Government, if it is determined that adequate space was available and installations could have been accommodated within the designated construction area through properly coordinated layout drawings. One (1) CQC certified copy of all layout drawings shall be available for the Government's review five (5) working days prior to scheduled commencement of the work. Submission shall be made upon Government's request.

3.7 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7.1 Monthly Updates of Submittal Registers

Monthly updates of the initially accepted Submittal Registers, ENG Form 4288, shall be provided in duplicate at the time the monthly progress payment is requested and be current to within one (1) week of the date of submission. Where a monthly progress payment is not being requested, update shall be submitted on the 15th of each month or a work day closest to the 15th. If the Contractor fails to provide the Government acceptable initial submittal registers or monthly updates within the specified time frames, the Government may issue a stop work order and withhold a portion of pending progress payments due to non-performance. Any resulting cost or time loss to the Contractor due to such Government action shall not be subject to a claim for the time extensions or for additional cost or damages by the Contractor. Furnishing of the submittal registers by the Contractor and the subsequent review by the Government do not relieve the Contractor of the obligation to comply with all of the contract submittal requirements; for example, even if a required submittal was not originally listed on the initial register accepted by the Government, the Contractor will still be responsible for providing such submittal in accordance with the contract. The following shall be provided on the monthly updates to the initially approved schedule:

Activity number, Transmittal number, Item Number, and contractor schedule and action dates, and government action dates, as appropriate.

3.8 GOVERNMENT APPROVED SUBMITTALS

Shop drawings furnished for Government approval, including "variations", shall be submitted in six (6) copies, to include resubmittals. Upon completion of review by the Government, five (5) copies will be retained by the Contracting Officer and one (1) copy will be returned to the Contractor.

3.9 INFORMATION ONLY SUBMITTALS

Shop drawings provided for Government information only shall be submitted in five (5) copies, to include resubmittals; none will be returned to the Contractor. Since approval by the Contracting Officer is not required on information only submittals, these may or may not be reviewed by the

Government; non-review by the Government does not constitute a waiver of any requirement of the contract drawings or specifications. Certification and approval by the Contractor Quality Control that a submittal meets the requirements of the contract shall signify completion of the review process. However, the Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. The Contractor is responsible for furnishing material conforming to the plans and specifications, and the Contracting Officer may require the removal and replacement of nonconforming material incorporated in the work. This does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or check testing by the Government in those instances where the technical specifications so prescribed.

3.10 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR (Firm Name)
 _____ Approved
 _____ Approved with corrections as noted on submittal data and/or attached sheets(s).
 SIGNATURE: _____
 TITLE: _____
 DATE: _____

3.11 SUBMITTAL CONTROL DOCUMENTS

Submittal control documents and all submittal to the Contracting Officer shall be addressed to:

U.S. Army Engineer District, Honolulu
Schofield Barracks
Resident Office, Bldg 230
Fort Shafter, Hawaii 96858-5440

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

FY03 & 04 WBR, I J K, PH 2C2 & 2D1, SB

CONTRACTOR

A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H G #	C L A S S I F I C A T I O N S I F I C A R T I C L E S /	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E R C D F R O M	D A T E F W D T O O T H E R	D A T E R C D F R O M O T H E R	A C T I O N C O D E		D A T E O F	D A T E R C D F R O M A P P R
	01320		SD-01 Preconstruction Submittals														
			Preliminary Project Schedule														
			Initial Project Schedule														
			Periodic Schedule Updates														
			SD-06 Test Reports														
			Narrative Report														
			Schedule Reports														
			SD-07 Certificates														
			Qualifications														
	01430		SD-06 Test Reports														
			Environmental Protection Plan		G												
	01452A		SD-07 Certificates														
			Special Inspector	1.3	G ED												
			Quality Assurance Plan	1.4	G ED												
	01525		SD-01 Preconstruction Submittals														
			Accident Prevention Plan (APP)	1.8	G												
			Activity Hazard Analysis (AHA)	1.9	G												
			Crane Work Plan														
			Proof of qualification	3.5.2													
			SD-06 Test Reports														
			Reports	1.13													
			Accident Reports	1.13.1													
			Monthly Exposure Reports	1.13.3													
			Regulatory Citations and	1.13.4													
			Violations														
			Crane Reports	1.13.5													

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION	PARAGRAPH	CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				REMARKS		
						SUBMIT	BY	MATERIAL NEEDED BY	ACTION	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION		DATE OF ACTION	DATE RCD FRM APPR AUTH
	01780		SD-02 Shop Drawings														
			As-Built Drawings														
			SD-03 Product Data														
			As-Built Record of Equipment and Materials														
			Warranty Management Plan														
			Warranty Tags														
			Final Clean-Up														
	01900		SD-01 Preconstruction Submittals														
			Organization Plan		G												
			Accident Prevention Plan		G												
			Activity Hazard Analyses		G												
			Phasing and Traffic Control Plans		G												
			SD-03 Product Data														
			Equipment Data														
			Recovered Material Report														
			SD-06 Test Reports														
			Inspection of Existing Conditions														
			Dust Control		G												
			Method(s) of dust control														
			Excavation/Trenching Clearance														
			Condition of Contractor's Operation or Storage Area.														
			SD-07 Certificates														
			Products Containing Recovered Materials														

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CONTRACTOR

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E R C D F R O M	D A T E F W D T O O T H E R	D A T E R C D F R O M	A C T I O N			D A T E O F	D A T E R C D F R O M
	02220		SD-03 Product Data Work Plan															
			SD-07 Certificates Demolition plan		G													
			Notifications	1.4.1	G													
			Notification of Demolition and Renovation forms	1.4.1	G													
			SD-11 Closeout Submittals Receipts	1.4.2														
	02286		SD-07 Certificates Basaltic Termite Barrier Materials															
	02300a		SD-03 Product Data Earthwork															
			SD-06 Test Reports Testing	3.13														
			SD-07 Certificates Testing	3.13														
	02315a		SD-06 Test Reports Testing	3.14														
	02316a		SD-06 Test Reports Field Density Tests	3.4.3														
			Testing of Backfill Materials	3.4.2														
	02510a		SD-03 Product Data Installation	3.1														
			Waste Water Disposal Method Satisfactory Installation															

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E O F
	02510a		SD-06 Test Reports															
			Bacteriological Disinfection															
			SD-07 Certificates															
			Manufacturer's Representative Installation	1.3														
			Meters	2.8.8														
	02531		SD-02 Shop Drawings															
			Precast concrete manhole															
			Metal items	2.3.4														
			Frames, covers, and gratings	2.3.4.1														
			SD-03 Product Data															
			Pipeline materials	2.1														
			SD-07 Certificates															
			Portland Cement															
	02555a		SD-02 Shop Drawings															
			Distribution System	3.4.9														
			SD-03 Product Data															
			Distribution System	3.4.9														
			SD-07 Certificates															
			Distribution System	3.4.9														
			Welding	1.6														
			SD-10 Operation and Maintenance Data															
			Distribution System	3.4.9														
	02630a		SD-03 Product Data															
			Placing Pipe	3.3														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F A C T I O N	D A T E F R O M C O N T R	D A T E F R O M R E V I E W E R	D A T E F R O M R E V I E W E R	D A T E O F A C T I O N		D A T E O F A C T I O N	
																	(g)
	02630a		SD-07 Certificates														
			Resin Certification	2.1.4													
			Resin Certification	2.1.5													
			Pipeline Testing	3.8													
			Determination of Density	3.7.5													
			Frame and Cover for Gratings	2.3.6													
	02721a		SD-03 Product Data														
			Equipment	1.6													
			SD-06 Test Reports														
			Sampling and Testing	1.4													
	02722a		SD-03 Product Data														
			Plant, Equipment, and Tools	1.5													
			Waybills and Delivery Tickets														
			SD-06 Test Reports														
			Sampling and testing	1.4													
			Field Density Tests	1.4.2.4													
	02741a		SD-03 Product Data														
			Mix Design	2.3													
			Contractor Quality Control	3.10	G												
			Material Acceptance and Percent	3.11													
			Payment														
			SD-04 Samples														
			Asphalt Cement Binder	2.2													
			Aggregates	2.1													
			SD-06 Test Reports														
			Aggregates	2.1													

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E O F
	02741a		QC Monitoring	3.10.3.10													
			SD-07 Certificates														
			Asphalt Cement Binder	2.2													
			Testing Laboratory	3.6													
	02748A		SD-03 Product Data														
			Waybills and Delivery Tickets														
			SD-06 Test Reports														
			Sampling and Testing	3.7													
	02763a		SD-03 Product Data														
			Equipment	1.4													
			Composition Requirements	2.2.1													
			Qualifications														
			SD-06 Test Reports														
			Sampling and Testing	2.4													
			SD-07 Certificates														
			Volatile Organic Compound (VOC)	2.2.3													
	02770a		SD-06 Test Reports														
			Field Quality Control	3.8													
			Equipment Calibration														
	02811a		SD-02 Shop Drawings														
			Sprinkler System	3.1													
			SD-03 Product Data														
			Framed Instructions	3.3													
			Field Training	3.4													
			Sprinkler System	3.1													

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A M E T E R S	G O V E R N M E N T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R	R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E R C D F R O M	D A T E F W D T O O T H E R	D A T E R C D F R O M	A C T I O N			D A T E O F	D A T E R C D F R O M
		02811a	Spare Parts															
			Design Analysis and Calculations															
			SD-06 Test Reports															
			Field Tests	3.2														
			SD-07 Certificates															
			Sprinkler System	3.1														
			SD-10 Operation and Maintenance Data															
			Sprinkler System	3.1														
		02821a	SD-07 Certificates															
			Chain Link Fence	2.1.1														
		02921a	SD-03 Product Data															
			Equipment															
			Surface Erosion Control Material	2.7														
			Chemical Treatment Material	1.4.3														
			Delivery	1.4.1														
			Finished Grade and Topsoil	3.2.1														
			Topsoil	2.2														
			Quantity Check	3.5														
			Seed Establishment Period	3.9														
			Maintenance Record	3.9.3.5														
			Application of Pesticide	3.6														
			SD-04 Samples															
			Delivered Topsoil	1.4.1.1														
			Soil Amendments	2.3														
			Mulch	2.4														

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CONTRACTOR

A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C S E C T	D E S C R I P T I O N	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R : A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F A C T I O N	D A T E F R O M C O N T R	D A T E F W D T O A P P R A U T H	D A T E F R O M O T H E R	D A T E F R O M O T H E R		D A T E O F A C T I O N	D A T E F R O M A P P R
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02921a	SD-06 Test Reports														
			Equipment Calibration	3.1.2													
			Soil Test	3.1.3													
			SD-07 Certificates														
			Seed	2.1													
			Topsoil	2.2													
			pH Adjuster	2.3.1													
			Fertilizer	2.3.2													
			Organic Material	2.3.4													
			Soil Conditioner	2.3.5													
			Mulch	2.4													
			Pesticide	2.6													
		02922a	SD-03 Product Data														
			Equipment	3.1.2													
			Chemical Treatment Material	1.4.3.2													
			Delivery	1.4.1													
			Finished Grade and Topsoil	3.2.1													
			Topsoil	2.2													
			Quantity Check	3.5													
			Sod Establishment Period	3.9													
			Maintenance Record	3.9.3.5													
			Application of Pesticide	3.6													
			SD-04 Samples														
			Delivered Topsoil	1.4.1.2													
			Soil Amendments	2.3													
			Temporary Seeding	3.4													

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CONTRACTOR

A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F A C T I O N	D A T E F R O M C O N T R	D A T E F R O M R E V I E W E R	D A T E F R O M O T H E R	D A T E F R O M O T H E R		D A T E O F A C T I O N	D A T E O F A C T I O N
	02922a		SD-06 Test Reports														
			Equipment Calibration	3.1.2													
			Soil Test	3.1.3													
			SD-07 Certificates														
			Sod	2.1													
			Topsoil	2.2													
			pH Adjuster	2.3.1													
			Fertilizer	2.3.2													
			Organic Material	2.3.4													
			Soil Conditioner	2.3.5													
			Pesticide	2.5													
	02930a		SD-02 Shop Drawings														
			Shop Drawings	3.3.1													
			Finished Grade, Topsoil and Underground Utilities	3.2.1													
			SD-03 Product Data														
			Geotextile	2.5													
			Chemical Treatment Material	1.4.3.2													
			Equipment	3.7.2													
			Delivery	1.4.1													
			Plant Establishment Period	3.9													
			Maintenance Record	3.9.2.6													
			Application of Pesticide	3.7													
			SD-04 Samples														
			Delivered Topsoil	1.4.1.3													
			Soil Amendments	3.1.2.2													

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CONTRACTOR

A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C T S E C T	D E S C R I P T I O N	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R	R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E F R O M
		02930a	Mulch	2.4														
			Geotextile	2.5														
			SD-06 Test Reports															
			Soil Test	3.1.2.2														
			SD-07 Certificates															
			Plant Material	2.1														
			Topsoil	2.2														
			pH Adjuster	2.3.1														
			Fertilizer	2.3.2														
			Organic Material	2.3.3														
			Soil Conditioner	2.3.4														
			Organic Mulch	2.4.2														
			Pesticide	2.13														
			SD-10 Operation and Maintenance															
			Data															
			Maintenance Instructions	3.9.5														
		02935a	SD-03 Product Data															
			Chemical Treatment Material	1.3.3														
			Work Plan and Schedule															
			Delivery Schedule	1.3.1														
			Maintenance Record	3.6.4														
			Application of Pesticide	3.5														
			SD-06 Test Reports															
			Soil Tests	3.1														
			Percolation Test															
			SD-07 Certificates															

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R	R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E F R O M
		02935a	pH Adjuster	2.1.1														
			Fertilizer	2.1.2														
			Mulch	2.2														
			Pesticide	2.4														
		03100a	SD-02 Shop Drawings															
			Formwork	3.1.1														
			SD-03 Product Data															
			Design	1.3														
			Form Materials	2.1														
			Form Releasing Agents	2.1.5														
		03150a	SD-03 Product Data															
			Preformed Expansion Joint Filler	2.2														
			GRE															
			Sealant	2.3														
			SD-07 Certificates															
			Preformed Expansion Joint Filler	2.2														
			GRE															
			Sealant	2.3														
		03200a	SD-02 Shop Drawings															
			Reinforcement	3.1														
			SD-03 Product Data															
			Welding	1.3														
			SD-07 Certificates															
			Reinforcing Steel	2.3														
		03300	SD-03 Product Data															
			Mixture Proportions	1.7	G													

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H #	C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R	R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E O F
	03300		SD-06 Test Reports															
			Testing and Inspection for Contractor Quality Control	3.13	G													
			SD-07 Certificates															
			Qualifications	1.4	G													
			SD-08 Manufacturer's Instructions															
			Application															
	04200		SD-02 Shop Drawings															
			Masonry Work		G													
			RE															
			SD-04 Samples															
			Concrete Masonry Units (CMU)	2.2	G													
			Anchors, Ties, and Bar Positioners	2.7														
			Expansion-Joint Materials	2.11	G													
			Joint Reinforcement	2.8														
			SD-05 Design Data															
			Pre-mixed Mortar	2.5.2	G													
			RE															
			Unit Strength Method	1.5.2	G													
			SD-06 Test Reports															
			Efflorescence Test		G													
			Field Testing of Mortar	3.16.1	G													
			Field Testing of Grout	3.16.2	G													
			Prism tests	3.16.3	G													
			Fire-rated CMU		G													

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E O F			D A T E O F
	04200		Special Inspection	1.5.1	G												
			SD-07 Certificates														
			Concrete Masonry Units (CMU)	2.2													
			Control Joint Keys	2.10													
			Anchors, Ties, and Bar Positioners	2.7													
			Expansion-Joint Materials	2.11													
			Joint Reinforcement	2.8													
			Reinforcing Steel Bars and Rods	2.9													
			Admixtures for Masonry Mortar														
			Admixtures for Grout														
	05120		SD-02 Shop Drawings														
			Erection drawings		G												
			Fabrication drawings	1.6.1	G												
			SD-03 Product Data														
			Shop primer	2.4													
			Load indicator washers														
			Load indicator bolts														
			SD-06 Test Reports														
			Class B coating														
			Bolts, nuts, and washers	2.2													
			SD-07 Certificates														
			Steel	2.1													
			Bolts, nuts, and washers	2.2													
			Shop primer	2.4													
			Welding electrodes and rods	2.3.1													

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						SUBMIT	BY	BY	ACTION	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION		DATE OF ACTION	DATE RCD FRM APPR AUTH
	05120		Nonshrink grout	2.3.2													
			Galvanizing	2.5													
			AISC Quality Certification	1.5													
			Welding procedures and qualifications	1.6.2.2													
	05300a		SD-02 Shop Drawings														
			Deck Units	2.1													
			Accessories	2.5													
			Attachments	3.2													
			Holes and Openings	3.3													
			SD-03 Product Data														
			Deck Units	2.1													
			Attachments	3.2													
			SD-04 Samples														
			Deck Units	2.1													
			Accessories	2.5													
			SD-07 Certificates														
			Deck Units	2.1													
			Attachments	3.2													
	05500a		SD-02 Shop Drawings														
			Miscellaneous Metal Items	1.6													
			SD-04 Samples														
			Miscellaneous Metal Items	1.6													
	06100a		SD-02 Shop Drawings														
			Nailers and Nailing Strips	3.2.2													
			SD-03 Product Data														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E R C D F R O M	D A T E F W D T O O T H E R	D A T E R C D F R O M O T H E R	A C T I O N			D A T E O F	D A T E R C D F R O M
		06100a	Product Installations															
			SD-07 Certificates															
			Grading and Marking	2.1.1														
			Insulation	2.3														
			Vapor Retarder															
		06200a	SD-02 Shop Drawings															
			Finish Carpentry															
			SD-04 Samples															
			Moldings and Base															
		06650	SD-02 Shop Drawings															
			Installation	3.2														
			SD-03 Product Data															
			Solid polymer material	2.1														
			Qualifications	1.6														
			Fabrications	2.3														
			SD-04 Samples															
			Material	2.1														
			Counter and Vanity Tops	2.3.4														
			SD-06 Test Reports															
			Solid polymer material	2.1														
			SD-07 Certificates															
			Fabrications	2.3														
			Qualifications	1.6														
			SD-10 Operation and Maintenance															
			Data															
			Solid polymer material	2.1														

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						SUBMIT	BY	MATERIAL NEEDED BY	A C T I O N C O D E	DATE OF A C T I O N	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N C O D E		DATE OF A C T I O N	DATE RCD FRM APPR AUTH
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)											(r)	
		06650	Clean-up														
		07131	SD-03 Product Data														
			Elastomeric waterproofing sheet material	2.1	G												
			Protection board														
			Primers, adhesives, and mastics	2.1													
			SD-06 Test Reports														
			Elastomeric waterproofing sheet material	2.1													
		07132a	SD-03 Product Data														
			Applications	2.1.2													
			SD-07 Certificates														
			Materials	1.4													
		07210	SD-02 Shop Drawings														
			Fastening Spacing														
			SD-07 Certificates														
			Inspection														
			SD-08 Manufacturer's Instructions														
			Application of Insulation														
		07220a	SD-03 Product Data														
			Application of Insulation	3.5													
			Inspection	3.6													
			SD-07 Certificates														
			Insulation	2.1													
		07240	SD-02 Shop Drawings														
			Shop drawings	3.3	G												

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E R C D F R O M	D A T E F W D T O O T H E R	D A T E R C D F R O M	A C T I O N			D A T E O F	D A T E R C D F R O M
	07240		SD-03 Product Data															
			Sheathing board	2.2														
			Adhesive	2.3														
			Mechanical Fasteners	2.4														
			Accessories	2.10														
			Base coat	2.5														
			Portland cement	2.6														
			Reinforcing fabric	2.7														
			Finish coat	2.8														
			Joint Sealant	2.11														
			Primer	2.9														
			Bond breaker	2.12														
			Backer Rod	2.13														
			Warranty	1.7														
			SD-04 Samples															
			Sample Boards	1.2.3.7	G													
			SD-05 Design Data															
			Moisture analysis	1.2.4														
			SD-06 Test Reports															
			Abrasion resistance	1.2.3.1														
			Accelerated weathering	1.2.3.2														
			Impact resistance	1.2.2.3														
			Mildew resistance	1.2.3.3														
			Salt spray resistance	1.2.3.4														
			Water vapor transmission															
			Absorption-freeze-thaw	1.2.3.6														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E O F		D A T E O F
	07240		Flame spread													
			Water resistance	1.2.3.5												
			Surface Burning Characteristics	1.2.2.1												
			Radiant heat	1.2.2.2												
			substrate	3.1												
			SD-07 Certificates													
			Qualifications of EFS	1.4.1												
			Manufacturer													
			Qualification of EFS Installer	1.4.2												
			Qualification of Sealant Applicator	1.4.3												
			Qualifications of Third Party													
			Inspector													
			Inspection Check List	3.5.2	G											
			SD-08 Manufacturer's Instructions													
			Installation	3.3												
			SD-10 Operation and Maintenance													
			Data													
			EFS	1.7												
	07416a		SD-02 Shop Drawings													
			Standing Seam Metal Roof		G											
			System													
			SD-03 Product Data													
			Design Analysis		G											
			Qualifications													
			SD-04 Samples													
			Accessories	2.3												

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F A C T I O N	D A T E R C D F R O M C O N T R	D A T E F W D T O O T H E R R E V I E W E R	D A T E R C D F R O M O T H E R R E V I E W E R	D A T E O F A C T I O N		D A T E R C D F R O M A P P R	
																	(g)
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
	07416a		Roof Panels	2.1													
			Factory Color Finish	2.6													
			Fasteners	2.4													
			Insulation	2.7													
			Gaskets and Insulating Compounds	2.10													
			Sealant	2.9													
			Concealed Anchor Clips	2.2													
			Subpurlins	2.5													
			EPDM Rubber Boots	2.12													
			SD-07 Certificates														
			Standing Seam Metal Roof System														
			Insulation	2.7													
	07600a		SD-02 Shop Drawings														
			Materials	2.1													
	07810		SD-03 Product Data														
			Fireproofing Material	3.3	G												
			SD-04 Samples														
			Spray-Applied Fireproofing	2.1	G												
			SD-06 Test Reports														
			Fire Resistance Rating	1.7	G												
			Field Tests	3.5	G												
			SD-07 Certificates														
			Installer Qualifications	1.5	G												
			Surface Preparation Report		G												

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C T N O	DESCRIPTION	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				REMARKS		
						SUBMIT	BY	BY	A C T I O N C O D E	DATE OF A C T I O N	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N C O D E		DATE OF A C T I O N	DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)											(r)	
	07810		Manufacturer's Inspection Report	3.5.3	G												
	07840a		SD-02 Shop Drawings														
			Firestopping Materials	2.1													
			SD-07 Certificates														
			Firestopping Materials	2.1													
			Installer Qualifications	1.5													
			Inspection	3.3													
	07900a		SD-03 Product Data														
			Backing	2.1													
			Bond-Breaker	2.2													
			Sealant	2.4													
			SD-07 Certificates														
			Sealant	2.4													
	08110		SD-02 Shop Drawings														
			Doors	2.1	G G												
			Doors	2.1	G G												
			Frames	2.3	G G												
			Frames	2.3	G G												
			Accessories	2.2													
			Weatherstripping	2.5													
			SD-03 Product Data														
			Doors	2.1	G												
			Frames	2.3	G												
			Accessories	2.2													
			Weatherstripping	2.5													
	08210		SD-02 Shop Drawings														

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						SUBMIT	BY	BY	A C T I O N C O D E	DATE OF A C T I O N	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N C O D E		DATE OF A C T I O N	DATE RCD FRM APPR AUTH
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08210	Doors	2.1	G												
			SD-03 Product Data														
			Doors	2.1	G												
			Accessories	2.3													
			Water-resistant sealer	2.4.6													
			warranty	1.4													
			Fire resistance rating		G												
			SD-04 Samples														
			Doors	2.1													
			Door finish colors	2.4.5.2	G												
			SD-06 Test Reports														
			Split resistance	2.5													
			Cycle-slam	2.5													
			Hinge loading resistance	2.5													
		08580	SD-02 Shop Drawings														
			Windows		G												
			SD-03 Product Data														
			Windows		G												
			Glass		G												
			Setting Materials		G												
			Fasteners		G												
			Accessories		G												
			Subframe		G												
			Hardware		G												
			Window Units		G												
			SD-04 Samples														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E O F			D A T E O F	D A T E O F	D A T E O F
	08580		Window units		G														
			SD-07 Certificates																
			Window units		G														
			SD-09 Manufacturer's Field Reports																
			Minimum condensation resistance factor																
			Deflection																
			Air infiltration																
			Water penetration																
			Blast resistance test reports		G														
			SD-10 Operation and Maintenance Data																
			Window units		G														
	08710		SD-02 Shop Drawings																
			Hardware schedule	1.3	G														
			Hardware schedule	1.6	G														
			Keying system	2.3.6															
			SD-03 Product Data																
			Hardware items	2.3	G														
			Card Key Access Control		G														
			SD-08 Manufacturer's Instructions																
			Installation	3.1															
			SD-10 Operation and Maintenance Data																
			Hardware Schedule	1.3	G														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E F R O M
	08710		Hardware Schedule	1.6	G												
			SD-11 Closeout Submittals														
			Key bitting	1.4													
	08810a		SD-02 Shop Drawings														
			Installation	3.2													
			SD-03 Product Data														
			Glazing Accessories	2.6													
			SD-07 Certificates														
			Glazing Accessories	2.6													
	09250		SD-03 Product Data														
			Cementitious backer units	2.1.3													
			Glass Mat Water-Resistant														
			Gypsum Tile Backing Board														
			Water-Resistant Gypsum Backing Board														
			Glass Mat Covered or Reinforced														
			Gypsum Sheathing														
			Glass Mat Covered or Reinforced														
			Gypsum Sheathing Sealant														
			Impact Resistant Gypsum Board														
			Accessories	2.1.8													
			SD-04 Samples														
			Predecorated gypsum board		G												
			SD-07 Certificates														
			Asbestos Free Materials	2.1	G												
	09310		SD-03 Product Data														

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C T N O	DESCRIPTION	P A R A G R A P H	G O V T C L A S S I F I C A T I O N	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				M A I L E D T O C O N T R A C T O R / R E M A R K S		
						S U B M I T	B Y	B Y	A C T I O N C O D E	D A T E O F A C T I O N	D A T E F W D T O A P P R A U T H	D A T E F W D T O O T H E R	D A T E R C D F R O M O T H E R	A C T I O N C O D E		D A T E O F A C T I O N	D A T E R C D F R O M A P P R
	09310		Tile	2.1													
			Setting-Bed	2.2													
			Mortar, Grout, and Adhesive	2.4													
			SD-04 Samples														
			Tile	2.1													
			Accessories	2.1.4													
			Marble Thresholds	2.5													
			SD-06 Test Reports														
			Testing														
			SD-07 Certificates														
			Tile	2.1													
			Mortar, Grout, and Adhesive	2.4													
	09510		SD-02 Shop Drawings														
			Approved Detail Drawings	1.3													
			SD-03 Product Data														
			Acoustical Ceiling Systems														
			SD-04 Samples														
			Acoustical Units	2.1													
			SD-06 Test Reports														
			Ceiling Attenuation Class and Test	1.3.1													
			SD-07 Certificates														
			Acoustical Units	2.1													
	09650		SD-02 Shop Drawings														
			Tile Flooring	2.1	G												
			SD-03 Product Data														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F W D T O O T H E R	D A T E F R O M	O T H E R			D A T E O F	D A T E F R O M
	09650		Tile Flooring	2.1														
			Adhesive for Vinyl Composition Tile	2.1.4														
			Adhesive for Wall Base	2.1.5														
			SD-04 Samples															
			Tile Flooring	2.1														
			Wall Base	2.3														
			SD-06 Test Reports															
			Moisture Test	3.3														
			Moisture and Alkalinity Tests															
			SD-08 Manufacturer's Instructions															
			Tile Flooring	2.1														
			SD-10 Operation and Maintenance Data															
			Data Package 1		G													
	09680A		SD-02 Shop Drawings															
			Installation	3.4														
			Molding	2.3														
			SD-03 Product Data															
			Carpet and Accessories															
			Surface Preparation	3.1														
			Installation	3.4														
			Regulatory Requirements	1.3														
			SD-04 Samples															
			Carpet and Accessories															
			Molding	2.3														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E F R O M	D A T E F R O M	D A T E F R O M
	09680A		SD-06 Test Reports																
			Moisture and Alkalinity Tests	3.2															
			SD-07 Certificates																
			Carpet and Accessories																
			SD-10 Operation and Maintenance Data																
			Carpet and Accessories																
			Cleaning and Protection	3.5															
	09880		SD-03 Product Data																
			Acrylic Textured Wall Coating																
			SD-08 Manufacturer's Instructions																
			Mixing and Thinning																
			Application																
			SD-07 Certificates																
			Applicator's Qualifications																
			Acrylic Textured Wall Coating																
			SD-04 Samples																
			Color																
			Acrylic Textured Wall Coating																
	09900		SD-02 Shop Drawings																
			Piping identification	3.10															
			stencil	3.10															
			SD-03 Product Data																
			Coating	2.1															
			Manufacturer's Technical Data	2.1															
			Sheets																

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						S U B M I T	B Y	B Y	A C T I O N C O D E	D A T E O F A C T I O N	D A T E F W D T O A P P R A U T H	D A T E F W D T O O T H E R	D A T E R C D F R O M O T H E R	A C T I O N C O D E			D A T E O F A C T I O N	D A T E R C D F R O M A P P R
	09900		SD-04 Samples															
			Color	1.9														
			SD-07 Certificates															
			Applicator's qualifications	1.3														
			Qualification Testing	1.4.1.2														
			SD-08 Manufacturer's Instructions															
			Application instructions															
			Mixing	3.6.2														
			Manufacturer's Material Safety	1.7.2														
			Data Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings	2.1														
	10100A		SD-03 Product Data															
			Visual Display Boards															
			SD-04 Samples															
			Aluminum	2.2.3														
			Porcelain Enamel	2.2.1														
			Materials	2.2														
			07 Certificates															
			Visual Display Boards															
	10153		SD-02 Shop Drawings															
			Toilet Partition System															
			SD-03 Product Data															
			Toilet Partition System															
			SD-04 Samples															

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E O F
		10153	Toilet Partition System															
		10430	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1														
			SD-03 Product Data															
			Modular Exterior Signage System	2.1														
			Installation	3.1														
			Exterior Signs															
			SD-04 Samples															
			Exterior Signs															
		10440	SD-02 Shop Drawings															
			Detail Drawings	3.1														
			SD-03 Product Data															
			Installation	3.1														
			SD-04 Samples															
			Interior Signage	1.3														
		10522	SD-08 Manufacturer's Instructions															
			Fire extinguisher cabinets															
			Fire extinguishers															
		10550	SD-02 Shop Drawings															
			Mailbox Installation															
			SD-03 Product Data															
			Mailboxes, Parcel Lockers, and															
			Mail Collection Boxes															
		10800	SD-03 Product Data															
			Finishes	2.1.2														
			Accessory Items	2.2														

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						SUBMIT	BY	BY	ACTION	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION		DATE OF ACTION	DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
	10800		SD-04 Samples														
			Finishes	2.1.2													
			Accessory Items	2.2													
			SD-07 Certificates														
			Accessory Items	2.2													
	11131		SD-02 Shop Drawings														
			Projection Screen														
			SD-03 Product Data														
			Projection Screen														
	12320A		SD-02 Shop Drawings														
			Installation	3.1													
			SD-03 Product Data														
			Cabinets	2.1													
			Countertops and Backsplash	2.2													
			SD-04 Samples														
			Cabinets	2.1													
			Countertops and Backsplash	2.2													
			SD-06 Test Reports														
			Cabinets and Countertops														
	12490A		SD-02 Shop Drawings														
			Approved Detail Drawings	3.1													
			SD-03 Product Data														
			Window Treatments	3.1													
			Hardware	1.2													
			SD-04 Samples														
			Window Treatments	3.1													

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E O F	D A T E O F
	13080		SD-02 Shop Drawings															
			Bracing and Coupling															
			Resilient Vibration Isolation Devices	3.7														
			Equipment Requirements															
			SD-03 Product Data															
			Bracing and Coupling															
			Equipment Requirements															
	13100A		SD-02 Shop Drawings															
			Drawings															
			SD-07 Certificates															
			Materials	2.1														
	13280A		SD-03 Product Data															
			Respiratory Protection Program	1.12	G													
			Cleanup and Disposal	3.9	G													
			Detailed Drawings		G													
			Materials and Equipment		G													
			Qualifications	1.5	G													
			Training Program	1.11	G													
			Medical Requirements	1.10	G													
			Encapsulants	2.1	G													
			SD-06 Test Reports															
			Exposure Assessment and Air Monitoring	3.7	G													
			Local Exhaust Ventilation	1.20														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E O F
	13280A		Licenses, Permits and Notifications	1.14	G												
			SD-07 Certificates														
			Vacuum, Filtration and Ventilation Equipment		G												
	13281A		SD-03 Product Data														
			Materials and Equipment	1.17	G												
			Expendable Supplies		G												
			Qualifications	1.5	G												
			SD-06 Test Reports														
			Licences, Permits, and Notifications	1.11	G												
			Accident Prevention Plan (APP)	1.7	G												
			Sampling and Analysis	1.13	G												
	13286N		SD-07 Certificates														
			Qualifications of CIH	1.8.1	G												
			Training Certification	1.8.1	G												
			PCB and Lamp Removal Work Plan	1.8.2	G												
			PCB and Lamp Disposal Plan	1.8.3	G												
			SD-11 Closeout Submittals														
			Transporter certification	3.5.2	G												
			Certification of Decontamination	3.2.4													
			Certificate of Disposal and/or recycling	3.5.2.1													
			DD Form 1348-1														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E F R O M
			Testing results	3.3.1													
			SD-02 Shop Drawings														
			Fire Alarm Reporting System	1.4.1													
			SD-03 Product Data														
			Storage Batteries	2.2													
			Voltage Drop														
			Special Tools and Spare Parts	2.7.3													
			Technical Data and Computer Software	1.5	G RE												
			Training	3.5													
			Testing	3.4													
			SD-06 Test Reports														
			Testing	3.4													
			SD-07 Certificates														
			Equipment														
			Qualifications	1.3.7													
			SD-10 Operation and Maintenance Data														
			Technical Data and Computer Software	1.5	G RE												
			SD-02 Shop Drawings														
			Sprinkler System Shop Drawings		G												
			As-Built Shop Drawings														
			SD-03 Product Data														
			Fire Protection Related	3.1	G												
			Submittals														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E O F
		13930A	Load Calculations for Sizing Sway Bracing Components and Equipment Data		G												
			Hydraulic Calculations Spare Parts	1.7	G												
			Preliminary Tests Procedures Final Acceptance Test Procedures		G												
			On-site Training Schedule Preliminary Tests Final Acceptance Test	3.10	G												
			Fire Protection Specialist Qualifications		G												
			Sprinkler System Installer Qualifications	1.9	G												
			SD-06 Test Reports Preliminary Tests Report Final Acceptance Test Report		G												
			SD-07 Certificates Fire Protection Specialist Inspection		G												
			SD-10 Operation and Maintenance Data Wet Pipe Sprinkler System														
		14210A	SD-02 Shop Drawings														

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M		D A T E O F	D A T E O F
	14210A		Elevator System														
			SD-03 Product Data														
			Training Data														
			Elevator System														
			Framed Instructions	3.6													
			Test Procedures		G												
			SD-04 Samples														
			Finishes														
			SD-06 Test Reports														
			Testing	3.5													
			SD-07 Certificates														
			Qualification Certificates														
			SD-10 Operation and Maintenance														
			Data														
			Elevator System		G												
	15070A		SD-02 Shop Drawings														
			Coupling and Bracing	3.1													
			Flexible Couplings or Joints	3.3													
			Equipment Requirements	1.3													
			Contractor Designed Bracing	1.2.4	G												
			SD-03 Product Data														
			Coupling and Bracing	3.1	G												
			Equipment Requirements	1.3	G												
			Contractor Designed Bracing	1.2.4	G												
			SD-07 Certificates														
			Flexible Ball Joints	2.2													

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						SUBMIT	BY	BY	A C T I O N C O D E	DATE OF A C T I O N	DATE FWD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N C O D E		DATE OF A C T I O N	DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
	15080A		SD-02 Shop Drawings														
			Mica Plates	3.2.2.4													
			SD-03 Product Data														
			General Materials	2.1													
			SD-04 Samples														
			Thermal Insulation Materials														
	15190A		SD-02 Shop Drawings														
			Gas Piping System	3.2													
			SD-03 Product Data														
			Qualifications														
			SD-06 Test Reports														
			Testing														
			Pressure Tests	3.15.1													
			Pressure Tests for Liquified	3.15.2													
			Petroleum Gas														
			Test With Gas	3.15.3													
	15400A		SD-02 Shop Drawings														
			Plumbing System	3.8.1													
			Electrical Schematics														
			SD-03 Product Data														
			Welding	1.5.1													
			Plumbing Fixture Schedule	3.9													
			Vibration-Absorbing Features	3.4													
			Plumbing System	3.8.1													
			SD-06 Test Reports														
			Tests, Flushing and Disinfection	3.8													

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						S U B M I T	B Y	B Y	A C T I O N	D A T E O F	D A T E F R O M	D A T E F R O M	D A T E F R O M	D A T E F R O M			D A T E F R O M	D A T E F R O M	D A T E F R O M
	15400A		Backflow Prevention Assembly Tests																
			SD-07 Certificates																
			Materials and Equipment																
			Bolts	2.1.1															
			SD-10 Operation and Maintenance																
			Data																
			Plumbing System	3.8.1															
	15895A		SD-02 Shop Drawings																
			Drawings	3.1.9															
			Installation	3.1															
			SD-03 Product Data																
			Components and Equipment	2.1															
			Test Procedures	2.11.1															
			Welding Procedures	3.1.1.1															
			System Diagrams		G														
			Similar Services																
			Welding Joints																
			Testing, Adjusting and Balancing	3.6															
			Field Training	3.8															
			SD-06 Test Reports																
			Performance Tests	3.7															
			SD-07 Certificates																
			Bolts	2.5.2.2															
			SD-10 Operation and Maintenance																
			Data																

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H #	G O V T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / R E M A R K S		
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			TAB Execution	3.4.1														
			TAB Verification	3.4.4														
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			SD-03 Product Data														

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C I F I C S E C T	D E S C R I P T I O N	P A R A G R A P H G #	G O V E R N M E N T C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / R E M A R K S		
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			Record Keeping and Documentation	1.8	G RE												
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					G RE												
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			Spare Parts														
			Equipment	1.5.1													

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A C T I V I T Y N O	T R A N S M I T T A L N O	S P E C T S E C T	D E S C R I P T I O N	P A R A G R A P H G #	C L A S S I F I C A T I O N	C O N T R A C T O R : S C H E D U L E D A T E S			C O N T R A C T O R : A C T I O N		A P P R O V I N G A U T H O R I T Y				M A I L E D T O C O N T R A C T O R / A U T H O R I T Y	R E M A R K S		
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			Testing	3.6														
			SD-07 Certificates															
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			Data															
			Operation and Maintenance															
			Manuals															

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No." This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
4. Submittals requiring expeditious handling will be submitted on a separate form.
5. Separate transmittal form will be used for submittals under separate sections of the specifications.
6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications -- also, a written statement to that effect shall be included in the space provided for "Remarks."
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i, to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

- | | | | |
|------|--|-------|---|
| A -- | Approved as submitted. | E -- | Disapproved (See attached). |
| B -- | Approved, except as noted on drawings. | F -- | Receipt acknowledged. |
| C -- | Approved, except as noted on drawings.
Refer to attached sheet resubmission required. | FX -- | Receipt acknowledged, does not comply as
noted with contract requirements. |
| D -- | Will be returned by separate correspondence. | G -- | Other (Specify) |
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG Form 4025-R)

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01415

METRIC MEASUREMENTS

- 1.1 REFERENCES
- 1.2 GENERAL
- 1.3 USE OF MEASUREMENTS
 - 1.3.1 Hard Metric
 - 1.3.2 Soft Metric
 - 1.3.3 Neutral
- 1.4 COORDINATION
- 1.5 RELATIONSHIP TO SUBMITTALS

-- End of Section Table of Contents --

SECTION 01415

METRIC MEASUREMENTS

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380	(1993) Practice for Use of the International System of Units (SI)
ASTM E 621	(1994; R 1999e1) Practice for Use of Metric (SI) Units in Building Design and Construction

1.2 GENERAL

This project includes metric units of measurements. The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the 11th CGPM in 1960. A number of circumstances require that both metric SI units and English inch-pound (I-P) units be included in a section of the specifications. When both metric and I-P measurements are included, the section may contain measurements for products that are manufactured to I-P dimensions and then expressed in mathematically converted metric value (soft metric) or, it may contain measurements for products that are manufactured to an industry recognized rounded metric (hard metric) dimensions but are allowed to be substituted by I-P products to comply with the law. Dual measurements are also included to indicate industry and/or Government standards, test values or other controlling factors, such as the code requirements where I-P values are needed for clarity or to trace back to the referenced standards, test values or codes.

1.3 USE OF MEASUREMENTS

Measurements shall be either in SI or I-P units as indicated, except for soft metric measurements or as otherwise authorized. When only SI or I-P measurements are specified for a product, the product shall be procured in the specified units (SI or I-P) unless otherwise authorized by the Contracting Officer. The Contractor shall be responsible for all associated labor and materials when authorized to substitute one system of units for another and for the final assembly and performance of the specified work and/or products.

1.3.1 Hard Metric

A hard metric measurement is indicated by an SI value with no expressed correlation to an I-P value. Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

1.3.2 Soft Metric

- a. A soft metric measurement is indicated by an SI value which is a mathematical conversion of the I-P value shown in parentheses (e.g. 38.1 mm (1-1/2 inches)). Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other controlling factor. The I-P value shall govern while the metric measurement is provided for information.
- b. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products. These measurements are indicated by a manufacturing hard metric product dimension followed by the substitute I-P equivalent value in parentheses (e.g., 190 x 190 x 390 mm (7-5/8 x 7-5/8 x 15-5/8 inches)).

1.3.3 Neutral

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

1.4 COORDINATION

Discrepancies, such as mismatches or product unavailability, arising from use of both metric and non-metric measurements and discrepancies between the measurements in the specifications and the measurements in the drawings shall be brought to the attention of the Contracting Officer for resolution.

1.5 RELATIONSHIP TO SUBMITTALS

Submittals for Government approval or for information only shall cover the SI or I-P products actually being furnished for the project. The Contractor shall submit the required drawings and calculations in the same units used in the contract documents describing the product or requirement unless otherwise instructed or approved. The Contractor shall use ASTM E 380 and ASTM E 621 as the basis for establishing metric measurements required to be used in submittals.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

1.2 ORDERING INFORMATION

-- End of Section Table of Contents --

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
Internet: <http://www.aci-int.org>

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4301 North Fairfax Dr., Suite 425
ATTN: Pubs Dept.
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: ari@ari.org
Internet: <http://www.ari.org>

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)
30 W. University Dr.
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
Internet: <http://www.amca.org>

ALUMINUM ASSOCIATION (AA)

900 19th Street N.W.
Washington, DC 20006
Ph: 202-862-5100
Fax: 202-862-5164
Internet: <http://www.aluminum.org>

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Ofc. Sq.
Suite 104
Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
Internet: <http://www.aamanet.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)
444 N. Capital St., NW, Suite 249
Washington, DC 20001
Ph: 800-231-3475 202-624-5800
Fax: 800-525-5562 202-624-5806
Internet: <http://www.aashto.org>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
Fax: 202-367-2155
Internet: <http://www.abma-dc.org>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
222 West Las Colinas Blvd., Suite 641
Irving, TX 75039-5423
Ph: 972-506-7216 or 800-290-2272
Fax: 972-506-7682
Internet: <http://www.concrete-pipe.org>
e-mail: info@concrete-pipe.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Dr.
Suite 600
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: <http://www.acgih.org>
E-mail: pubs@acgih.org

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Dept.
1111 Nineteenth St. NW, Suite 800
Washington, DC 20036
Ph: 800-294-2372 or 202-463-2700
Fax: 202-463-2471

Internet: <http://www.afandpa.org/awc/>

AMERICAN GAS ASSOCIATION (AGA)
400 N. Capitol St. N.W. Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Fax: 202-824-7115
Internet: <http://www.aga.org>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Publications: 800-644-2400
Fax: 312-670-5403
Internet: <http://www.aisc.org>

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1101 17th St., NW Suite 1300
Washington, DC 20036
Ph: 202-452-7100
Internet: <http://www.steel.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
Internet: <http://www.ansi.org/>

Note --- Documents beginning with the letter "S" can be ordered from:

Acoustical Society of America
Standards and Publications Fulfillment Center
P. O. Box 1020
Sewickley, PA 15143-9998
Ph: 412-741-1979
Fax: 412-741-0609
Internet: <http://asa.aip.org>
General e-mail: asa@aip.org
Publications e-mail: asapubs@abdintl.com

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)
1250 I St., NW, Suite 500
Washington, DC 20005-3922
Ph: 202-789-2900
FAX: 202-789-1893
Internet: <http://www.anla.org>

AMERICAN PETROLEUM INSTITUTE (API)
1220 L St., NW
Washington, DC 20005-4070
Ph: 202-682-8000

Fax: 202-682-8223
Internet: <http://www.api.org>

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)
8201 Corporate Dr., Suite 1125
Landover, MD 20785-2230
Ph: 301-459-3200
Fax: 301-459-8077
Internet: <http://www.arema.org>

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6222
Internet: <http://www.asce.org>
e-mail: marketing@asce.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
Internet: <http://www.ashrae.org>

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
901 Canterbury, Suite A
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
E-mail: asse@ix.netcom.com
Internet: <http://www.asse-plumbing.org>

AMERICAN WATER WORKS ASSOCIATION(AWWA)
6666 West Quincy
Denver, CO 80235
Ph: 800-926-7337 - 303-794-7711
Fax: 303-794-7310
Internet: <http://www.awwa.org>

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
Internet: <http://www.amweld.org>

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)
P.O. Box 5690
Grandbury, TX 76049-0690
Ph: 817-326-6300
Fax: 817-326-6306

Internet: <http://www.awpa.com>

ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)

The Access Board
1331 F Street, NW, Suite 1000
Washington, DC 20004-1111
PH: 202-272-5434
FAX: 202-272-5447
Internet: <http://www.access-board.gov>

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)
PMB114-1745 Jefferson Davis Highway
Arlington, VA 22202
Ph: 514-861-1153
Fax: 514-861-1152
Internet: None

ASME INTERNATIONAL (ASME)
Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: <http://www.asme.org>

ASPHALT INSTITUTE (AI)
Research Park Dr.
P.O. Box 14052
Lexington, KY 40512-4052
Ph: 859-288-4960
Fax: 859-288-4999
Internet: <http://www.asphaltinstitute.org>

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 K St., NW, Suite 503
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833
Internet: <http://www.aabchq.com>
E-mail: aabchq@aol.com

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 No. 18th St.
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
Internet: <http://www.aeic.org>

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Ave.
17th floor
New York, NY 10017-6603
Ph: 212-297-2122

Fax: 212-370-9047
Internet: <http://www.buildershardware.com>

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SECTION 01430

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STATE OF HAWAII DEPARTMENT OF HEALTH (HIDOH)

HIDOH, Chapter 43	Administrative Rules, Title 11, Community Noise Control for Oahu
HIDOH, Chapter 59	Administrative Rules, Ambient Air Quality Standards
HIDOH, Chapter 60	Administrative Rules, Air Pollution Control

1.2 GENERAL REQUIREMENTS

This section covers prevention of environmental pollution and damage as the result of construction operations under this contract and for those measures set forth in the TECHNICAL REQUIREMENTS. For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual aesthetics, noise, solid waste, radiant energy and radioactive materials, as well as other pollutants.

1.2.1 Subcontractors

Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor.

1.2.2 Notification

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with the aforementioned Federal, State or local laws or regulations, permits, and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action as may be approved. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part

of the work until satisfactory corrective action has been taken. No time extensions will be granted or costs or damages allowed to the Contractor for any such suspension.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Environmental Protection Plan; G.

Within 30 calendar days of receipt of Notice to Proceed, the Contractor shall submit in writing an environmental protection plan. Approval of the Contractor's plan will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and other environmental protection measures.

The environmental protection plan shall include but not be limited to the following:

- a. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
- b. Methods for protection of features to be preserved within authorized work areas. The Contractor shall prepare a listing of methods to protect resources needing protection; i.e., trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archeological, and cultural resources.
- c. Procedures to be implemented to provide the required environmental protection and to comply with the applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures set out in accordance with the environmental protection plan.
- d. Location of the solid waste disposal area.
- e. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
- f. Environmental monitoring plans for the job site, including land, water, air, and noise monitoring.

- g. Traffic control plan.
- h. Methods of protecting surface and ground water during construction activities.
- i. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas.
- j. Plan of borrow area(s).
- k. Training for his personnel during the construction period.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 PROTECTION OF ENVIRONMENTAL RESOURCES

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications.

3.1.1 Land Resources

Prior to the beginning of any construction, the Contractor shall identify all land resources to be preserved within the Contractor's work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without special permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.

3.1.1.1 Work Area Limits

Prior to any construction, the Contractor shall mark the areas that are not required to accomplish all work to be performed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor shall convey to his personnel the purpose of marking and/or protection of all necessary objects.

3.1.1.2 Protection of Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly

identified by marking, fencing, or wrapping with boards, or any other approved techniques.

3.1.1.3 Reduction of Exposure of Unprotected Erodible Soils

Earthwork brought to final grade shall be finished as indicated and specified. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in instances where the constructed feature obscures borrow areas, quarries, and waste material areas, these areas shall not initially be cleared in total. Clearing of such areas shall progress in reasonably sized increments as needed to use the areas developed as approved by the Contracting Officer.

3.1.1.4 Protection of Disturbed Areas

Such methods as necessary shall be utilized to effectively prevent erosion and control sedimentation, including but not limited to the following:

- a. Retardation and Control of Runoff: Runoff from the construction site shall be controlled by construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses, and any measures required by areawide plans approved under Paragraph 208 of the Clean Water Act.
- b. Erosion and Sedimentation Control Devices: The Contractor shall construct or install all temporary and permanent erosion and sedimentation control features as indicated on the drawings. Temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching shall be maintained until permanent drainage and erosion control facilities are completed and operative.

3.1.1.5 Contractor Facilities and Work Areas

- a. Location of Field Offices, Storage, and Other Contractor Facilities: The Contractors' field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only on approval by the Contracting Officer.
- b. Borrow Areas on Government Property: Borrow areas shall be managed to minimize erosion and to prevent sediment from entering nearby waters.
- c. Temporary Excavations and Embankments: Temporary excavations and embankments for plant and/or work areas shall be controlled to protect adjacent areas from despoilment.

3.1.2 Disposal of Wastes

Disposal of wastes shall be as specified in Section 02220 DEMOLITION and as specified hereinafter.

3.1.2.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. All handling and disposal shall be conducted to prevent contamination. Segregation measures shall be employed such that no hazardous or toxic waste will become commingled with solid waste. The Contractor shall transport all solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. The Contractor shall comply with and local laws and regulations pertaining to the use of landfill areas.

3.1.2.2 Chemical Wastes:

Chemical wastes shall be stored in corrosion resistant containers, removed from the work area and disposed of in accordance with Federal, State, and local laws and regulations.

3.1.2.3 Hazardous Wastes:

The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing and shall collect waste in suitable containers observing compatibility. The Contractor shall transport all hazardous waste off Government property and dispose of it in compliance with Federal and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the responsibility of the Contractor.

3.1.3 Historical, Archeological, and Cultural Resources

Existing historical, archeological, and cultural resources within the Contractor's work area will be so designated by the Contracting Officer if any has been identified. The Contractor shall take precautions to preserve all such resources as they existed at the time they were pointed out to him. The Contractor shall provide and install all protection for these resources so designated and shall be responsible for their preservation during this contract. If during excavation or other construction activities, any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. These resources or cultural remains (prehistoric or historic surface or subsurface) include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, paving, wall, or other constructed features; and any indication of agricultural or other uses. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer. When so notified, the Contracting Officer will initiate action so that prompt and proper data recovery can be accomplished. In the mean time, recording and preservation of historical and archeological finds during construction activities shall be reported in accordance with the SPECIAL CONTRACT REQUIREMENTS.

3.1.4 Water Resources

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. All activities, equipment processes, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict conformance with the State of Hawaii Department of Health (HIDOH) Administrative Rules, Chapter 11-54 and HIDOH Administrative Rules, Chapter 11-55. The Whole Barracks Renewal (WBR) Project has a National Pollution Discharge Elimination System (NPDES) General Permit pending with the NIDOH.

The The government has prepared a DOH CWB-NOI Form C (Notice of Intent (NOI) for HAR Chapter 11-55 Appendix C- NPDES General Permit Coverage Authorizing Discharges of Storm Water Associated with Construction Activity) covering the general aspects of the entire Phase 2 project (FY00 to 07 projects) has been submitted to the DOH CWB. A general Best Management Practices (BMP) Plan addressing general aspects of the overall project and NOI Form C #16 has also been submitted. Contractor shall abide by all requirements set forth in the CWB-NOI Form C on file at the State DOH (NGPC File No. HI R 10B146). Contractor is responsible for preparing and submitting all items required to satisfy DOH requirements pertaining to the FY03 Ph 2C2 & FY04 Ph 2D1 WBR, IJK, SB project NPDES permit application. Any variations to the CWB NOI Form C (attached) enlisted by the Contractor shall be submitted to the Contracting Officer or his representative for approval. Once approved, Contractor shall incorporate proposed changes in his site specific plans and submit them to the State DOH a minimum of 30 days prior to the start of construction operations to obtain permit coverage for this phase of the WBR project.

The following CWB-NOI Form C Items are required to be provided by the Contractor:

Item #	Description
3.	General Contractor Information (see Guidelines for CWB-NOI Form C - Note 3). (Note: If Contractor main office location is not a local address, Contractor shall also submit a local address, contact person & title, phone & fax nos.
15.	Project Site Maps (see Guidelines for CWB-NOI Form C - Note 15): 1. Provide a phasing map identifying each phase of the FY03 Phase 2C2 & FY04 Phase 2D1 project. 2. Attach Site Maps (i.e., site plan, grading plan, drainage plan, erosion control plan, etc. folded to 8-1/2 x 11 inches) which shows the information requested in Item 15.2.1 through 15.2.8.
16.	Site-Specific Construction Best Management Practices (BMP) Plan (see Guidelines for CWB-NOI Form C - Note 16). The site specific construction BMP plan shall be signed in accordance with HAR Section 11-55-34.08(e). The site-specific construction

Item #	Description
	BMP plan shall be kept at the construction site.
18.	Additional Information (see Guidelines for CWB-NOI Form C - Note 18).

Contractor shall obtain all required additional NPDES permits for construction activities (submitting a DOH Notice of Intent (NOI) to be Covered Under General Permit, along with applicable HAR Chapter 11-55 Appendix/Appendices (B, C, D, E, F, G, H and/or I). Contractor is responsible for all applicable filing fees (if required) and for preparation of required supporting documents.

As specified in Section 342D-11 Hawaii Revised Statutes, if the project has any storm water discharge before a Notice of General Permit Coverage (NGPC) is issued, the permittee could face penalties of up to \$25,000 per day per violation. Contractor shall be fully liable for the entire amount of any and all penalties imposed as a result of his actions (e.g. if work is begun prior to receiving NGPC and the state imposes penalties for storm water discharge to the Government, the Contractor shall be responsible for all penalties).

3.1.4.1 Washing and Curing Water

Waste waters directly derived from water disinfection construction activities shall not be allowed to enter any drainage system unless it meets the requirements of the Hawaii Administrative Rules Chapter 11-54, Water Quality Standards. The chlorinated disinfection water may be used for watering grassy areas if the chlorine concentration is reduced to that of drinking water.

3.1.6 Air Resources

The Contractor shall keep construction activities under surveillance, management and control to minimize pollution of air resources. All activities, equipment, processes, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with HDOH, Chapter 59, HDOH, Chapter 60, and all Federal emission and performance laws and standards. Ambient Air Quality Standards set by the Environmental Protection Agency shall be maintained for those construction operations and activities specified in this section. Special management techniques as set out below shall be implemented to control air pollution by the construction activities which are included in the contract.

3.1.5 Particulates

- a. Dust particles, aerosols, and gaseous by-products from all construction activities, processing and preparation of materials, such as from asphaltic batch plants, shall be controlled at all times, including weekends, holidays and hours when work is not in progress.

- b. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards mentioned in paragraph Air Resources, herein before, to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated at such intervals as to keep the disturbed area damp at all times. The Contractor must have sufficient competent equipment available to accomplish this task. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

3.1.6 Hydrocarbons and Carbon Monoxide

Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.

3.1.7 Odors

Odors shall be controlled at all times for all construction activities, processing and preparation of materials.

3.1.8 Monitoring of Air Quality

Monitoring of air quality shall be the responsibility of the Contractor. All air areas affected by the construction activities shall be monitored by the Contractor. Monitoring results will be periodically reviewed by the Government to ensure compliance.

3.1.9 Sound Intrusions

The Contractor shall keep construction activities under surveillance, and control to minimize damage to the environment by noise. The Contractor shall comply with the provisions of HIDOH, Chapter 43.

3.2 POST CONSTRUCTION CLEANUP

The Contractor shall clean up area(s) used for construction.

3.3 RESTORATION OF LANDSCAPE DAMAGE

The Contractor shall restore all landscape features damaged or destroyed during construction operations inside and outside the limits of the approved work areas. Such restoration shall be in accordance with the plan submitted for approval by the Contracting Officer. This work will be accomplished at the Contractor's expense.

3.4 MAINTENANCE OF POLLUTION CONTROL FACILITIES

The Contractor shall maintain all constructed facilities and portable pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.5 TRAINING OF CONTRACTOR PERSONNEL IN POLLUTION CONTROL

The Contractor shall train his personnel in all phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, and installation and care of facilities (vegetative covers, and instruments required for monitoring purposes) to ensure adequate and continuous environmental pollution control.

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SECTION 01452A

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M	(1995) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 530/530.1	(1995) Building Code Requirements for Masonry Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Special Inspector; G, ED

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Assurance Plan; G, ED

A copy of the Quality Assurance Plan covered by a certificate

indicating that the plan meets the content specified in this section.

1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

1.4 QUALITY ASSURANCE PLAN

A quality assurance plan shall be developed containing the following:

a. A list of all items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.

b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.

c. The content, distribution, and frequency of special inspection reports.

d. The content, distribution, and frequency of testing reports.

e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.5.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Continuous special inspection shall be performed where specified for items as shown on the drawings.

1.5.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed.

The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Periodic special inspection shall be performed where specified for items as shown on the drawings.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

Special Inspections shall be performed for the following:

3.1.1 Reinforcing Steel

Periodic special inspection during and upon completion of the placement of reinforcing steel in shear walls.

3.1.2 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete in boundary members of shear walls.

3.1.3 Concrete Masonry Unit

Periodic special inspection during the preparation of mortar, the laying of masonry units, and placement of reinforcement and prior to placement of grout. For all concrete masonry unit.

3.1.4 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

For Barracks Buildings (BK-1 & BK-2) only.

a. Periodic special inspection during the erection and fastening of interior nonloadbearing partition walls.

b. Periodic special inspection during the anchorage of suspended ceilings.

3.1.5 Mechanical and Electrical Components

Special inspection of the mechanical and electrical components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were

actually installed. Special inspection for mechanical and electrical components shall be as follows:

- a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.
- b. Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.
- c. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

3.2 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

a. Reinforcing Steel: Special testing of reinforcing steel shall be as follows:

(1) Examine certified mill test reports for each shipment of reinforcing steel used in reinforced concrete boundary members of reinforced concrete shear walls and reinforced masonry shear walls. The special inspector shall determine conformance with the construction documents.

(2) Examine the reports for chemical tests, done in accordance with Sec. 3.5.2 of ACI 318M, which were performed to determine the weldability of ASTM A 615/A 615M reinforcing steel.

b. Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318M and comply with all acceptance provisions contained therein.

c. Structural Masonry: Verify that all quality assurance testing of structural masonry along with all material components is in accordance with the requirements of ACI 530/530.1 and complies with all acceptance provisions contained therein.

3.3 REPORTING AND COMPLIANCE PROCEDURES

- a. On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report

shall be signed by the Contractor.

- b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors. The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

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SECTION 01455

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 (1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

1.3 SUBMITTAL

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Quality Control Plan; G.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The burden of proof of contract compliance is placed on the Contractor and not assumed by the Government. The Contractor's Quality Control (CQC) System shall not be accepted without question and the right to inspect or verify the work at any time is reserved by the Government. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

3.2 QUALITY CONTROL PLAN

3.2.1 General

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 90 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work not identified in the features of work included in an accepted plan will not be permitted to begin until acceptance of a supplemental or amended CQC Plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Technicians responsible for sampling and testing of concrete shall be certified by the American Concrete Institute (ACI) or the Concrete Technicians Association of Hawaii (CTAH). Proof of certification shall be included in the CQC Plan. Personnel qualifications may be furnished incrementally as the work progresses,

but in no case, less than fourteen (14) calendar days before personnel are required on the job.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. A similar letter is required for the Assistant CQCSM. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.

f. For all proposed QC materials testing laboratories the contractor must submit the current Certificate of Accreditation and Scope of Accreditation (Test Procedures/Methods Approved) from one of the nationally recognized accreditation authority listed in paragraph 3.7.2.1. The submitted accreditations shall include the test methods required by the Contract, and must be less than 2 years old.

g. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

h. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

i. Reporting procedures, including proposed reporting formats.

j. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on

satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.2.5 Corrective Actions

Anytime it is determined by the Government that the Contractor's Quality Control system is not entirely satisfying the contract requirements, corrective action shall be taken by the Contractor to the satisfaction of the Contracting Officer. A portion of the payments to the Contractor shall be withheld for non-performance until an acceptable Quality Control system is established, implemented and enforced by the Contractor, including revisions to the organization due to deficient management. In addition, no work shall be performed on the contract or Government identified areas of work where the Government determines that the Quality Control system is ineffective. No time loss, due to issuance of the Government's stop work order, and/or any possible impact shall be made the subject of a claim for time extension or for additional costs or damages by the Contractor.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 General

The Quality Control System shall be implemented by the prime Contractor utilizing not less than the following Quality Control staff at the jobsite.

The actual strength of the staff may vary during any specific work period to cover the needs of the work phases. However, the CQC organization shall be sufficient qualifications and size, satisfactory to the Contracting

Officer, to insure contract compliance. Qualifications shall consider both experience and technical training to perform the assigned responsibilities.

Of primary consideration, whether an individual's qualifications are acceptable to the Contracting Officer, shall be the proposed individual's past experiences with projects of similar complexity, magnitude and type/scope of work. The CQC personnel listed below shall work directly for the CQCSM, be employed by the prime Contractor and be assigned no other duties than what is described below. The requirements for CQC personnel described below are in addition to other specified technical representatives such as registered land surveyor, consultant, manufacturer's representatives, etc., that may be required under the other sections of the Technical Specifications.

3.4.2 CQC System Manager (CQCSM) and Assistant CQCSM

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be both a Registered Professional Engineer and a construction person with a minimum of 10 years in related work experience, i.e. - CQCSM or Superintendent on projects of similar complexity, magnitude and type/scope of work. (Note: The requirement for a registered professional engineer may be waived if the Assistant CQCSM is a registered professional engineer.) This CQC System manager shall be on the site at all time during construction and shall be employed by the prime Contractor. The CQC System Manger shall be assigned no other duties. A full time Assistant CQCSM shall also be identified. The qualifications for the Assistant CQCSM shall be the same as that for the CQCSM except as noted above. The Assistant CQCSM shall work directly for the CQCSM in managing the CQC system,, be on site at all times, be employed by the prime Contractore, be assigned no other duties, and shall act in behalf of the CQCSM in his absense.

3.4.3 Engineering Technician

One full time Engineering Technician shall be provided physically on site for the duration of the contract to coordinate the prime Contractor's submittal system and monitor the effectiveness of the Contractor's system for handling Government-furnished property in accordance with the contract requirements. The Technician may also be utilized to assist and coordinate the preparation and submittal of O&M manuals, posted schematics/diagrams, etc., for systems operations, and preparation of training plans and testing plans.

3.4.4 Clerical Staff

Sufficient Clerical help, one minimum, shall be provided physically on site for the duration of the contract to insure the completion and/or submission in a timely manner of all reports, memoranda, charts, and other data required in accordance with the contract.

3.4.5 Quality Control Representatives

A minimum of two full type Quality Control Representative shall be provided

physically on site for the duration of the contract, under the direct supervision of the CQCSM, to assist with submittal review, daily review of on-going construction, safety, and other related duties as assigned. These QC representatives shall have a minimum of 5 years relative experience on projects of similar complexity, type and scope of work. Additional QC representatives shall be provided as required to verify that the on-going construction is in full compliance with the contract requirements.

3.4.6 Required QC Specialist

Provide separate QC specialist(s) at the work site for each of the areas of responsibilities, specified below, who will assist and report to the CQCSM and who will have no other duties other than reviewing submittals, performing the three phases of control and preparing documentation required by this contract. QC Specialists shall perform these duties for each definable feature of work in their area of responsibility at the frequency specified below.

Qualifications/Experience in Area of Responsibility	Area of Responsibility	Frequency
Registered Electrical Engineer, P.E./5 years minimum as P.E.	Electrical/Communication	To review all elec/comm submittals and minimum twice per week while work is being performed and until all elec/comm. Equipment accepted by the Government.
Registered Mechanical Engineer, P.E./5 years minimum as P.E.	Mechanical/HVAC Equipment and Systems	To review all Mech/HVAC submittals and minimum twice per week while work is being performed until all Mech/HVAC Equip/Sys accepted by the Government.
Certified Concrete/Masonry Inspector, 5 years minimum experience.	Formwork, Reinforcing Steel, Concrete and Masonry	Continuous while work is being performed.

3.4.7 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization additional specialized personnel to assist the CQC System Manager as may be required. If it is subsequently determined by the Contracting Officer that the minimum contract CQC requirements are insufficient/ineffective, the Contractor may be required to provide additional staff personnel to the CQC organization at no cost to the Government.

3.4.8 Additional Requirement

In addition to the above experience and/or education requirements, the CQC System Manager and the Assistant CQCSM shall have completed the course entitled "Construction Quality Management For Contractors" within the past 5 years. This course is periodically offered at the General Contractors Association of Hawaii.

3.4.9 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS

Submittals shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Discussion of the initial control phase.
- k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.
- l. The preparatory phase shall be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase shall be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall obtain the services of an industry recognized testing laboratory, or may establish a testing laboratory at the project site acceptable to the Contracting Officer. However, tests contractually required to be performed by an industry recognized testing laboratory shall not be accomplished by the Contractor established on-site laboratory. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the

sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Laboratory Accreditation

The testing laboratory performing the actual testing on the project shall be accredited by one of the following laboratory accreditation authorities:

American Association of State Highway and Transportation Officials
National Voluntary Laboratory Accreditation Program
American Association for Laboratory Accreditation
Washington Association of Building Officials

The testing laboratory shall submit an acknowledgement letter from one of the listed laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process started.

3.7.2.2 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.3 Capability Recheck

If the selected laboratory fails the capability check, the Contractor shall reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to a testing

laboratory on the Island of Oahu, State of Hawaii, designated by the Contracting Officer. Coordination for each specific test, exact delivery location, and dates will be made through the Government field office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be occupied. The QC Manager shall develop a punch list of items which do not conform to the contract documents. The Government will review the punch list and add to or correct the items listed. The QC Manager shall incorporate Government comments and provide a Pre-Final Punch List. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional

inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be prepared using government-provided software, QCS (see Section 01312), that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Unless otherwise directed by the Contracting Officer. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract.

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SECTION 01525

SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z359.1 (1992; R 1999) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2000) Safeguarding Construction, Alteration, and Demolition Operations

NFPA 51B (2003) Fire Prevention During Welding, Cutting, and Other Hot Work

NFPA 70 (2002) National Electrical Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1910.146 Permit-required Confined Spaces

29 CFR 1910.94 Ventilation

29 CFR 1915 Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment

29 CFR 1926 Safety and Health Regulations for Construction

29 CFR 1926.500 Fall Protection

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

Crane Critical Lift Plan

Crane Work Plan

Proof of qualification for Crane Operators

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Monthly Exposure Reports

Regulatory Citations and Violations

Crane Reports

SD-07 Certificates

Confined Space Entry Permit

1.3 DEFINITIONS

a. Associate Safety Professional (ASP). An individual who is currently certified as an ASP by the Board of Certified Safety Professionals.

b. Certified Construction Health & Safety Technician (CHST). An individual who is currently certified as a CHST by the Board of Certified Safety Professionals.

c. Certified Industrial Hygienist (CIH). An individual who is currently certified as a CIH by the American Board of Industrial Hygiene.

d. Certified Safety Professional (CSP). An individual who is currently

certified as a CSP by the Board of Certified Safety Professionals.

e. Certified Safety Trained Supervisor (CSTS). An individual who is currently certified as an STS by the Board of Certified Safety Professionals.

f. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

g. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

h. Low-slope roof. A roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

i. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

j. Multi-Employer Work Site (MEWS). A multi-employer work site, as defined by OSHA, is one in which many employers occupy the same site. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors.

k. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

l. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, extensive knowledge, training and experience in the field of fall protection who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

m. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

- (1) Death, regardless of the time between the injury and death, or the length of the illness;
- (2) Days away from work;
- (3) Restricted work;
- (4) Transfer to another job;
- (5) Medical treatment beyond first aid;
- (6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

n. Site Safety and Health Officer (SSHO). The superintendent or other qualified or competent person who is responsible for the on-site safety and health required for the project. The CQC System Manager (CQCSM) cannot be the SSHO, even though the CQCSM has safety inspection responsibilities as part of the QC duties.

o. Steep roof. A roof having a slope greater than 4 in 12 (vertical to horizontal).

p. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1, and federal, state, and local, laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.5 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employee uses illegal drugs or consumes alcohol during work hours. Ensure there are no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine, or saliva specimens and test the injured and involved employees for the influence of drugs and alcohol. A copy of the test shall be made available to the Contracting Officer upon request.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Site Safety and Health Officer (SSHO) shall be provided at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The SSHO shall meet the following requirements:

Level 3:

A minimum of 5 years safety work on similar projects.
30-hour OSHA construction safety class or equivalent within the last 5 years.

An average of at least 24 hours of formal safety training each year for the past 5 years.
Competent person training as needed.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Safety inspection logs shall be attached to the Contractors' daily quality control report.
- b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.
- c. Maintain applicable safety reference material on the job site.
- d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.
- e. Implement and enforce accepted APPS and AHAs.
- f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. A list of unresolved safety and health deficiencies shall be posted on the safety bulletin board.
- g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties may result in dismissal of the SSHO, and/or a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.6.3 Meetings

1.6.3.1 Safety Coordination Meeting

- a. The Contractor will be informed, in writing, of the date of the safety coordination meeting. The purpose of the safety coordination meeting is for the Contractor and the Contracting Officer's representatives to become acquainted and explain the functions and operating procedures of their respective organizations and to reach mutual understanding relative to the administration of the overall project's Accident Prevention Plan (APP) before the initiation of work.
- b. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the safety coordination meeting. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the

development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

c. The Contractor shall discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the meeting and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, a schedule for the preparation, submittal, review, and acceptance of AHAs shall be established to preclude project delays.

d. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the safety coordination meeting, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Work shall not begin until there is an accepted APP.

1.6.3.2 Weekly Safety Meetings

Conduct weekly safety meetings at the project site for all employees. The Contracting Officer will be informed of the meeting in advance and be allowed attendance. Minutes showing contract title, signatures of attendees and a list of topics discussed shall be attached to the Contractors' daily quality control report.

1.6.3.3 3-Phase Control Meetings

The appropriate AHA shall be reviewed and attendance documented by the Contractor at the preparatory, initial, and follow-up phases of quality control inspection. The analysis should be used during daily inspections to ensure the implementation and effectiveness of safety and health controls.

1.7 TRAINING

1.7.1 New Employee Indoctrination

New employees (prime and sub-contractor) will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.7.2 Periodic Training

Provide Safety and Health Training in accordance with USACE EM 385-1-1 and the accepted APP. Ensure all required training has been accomplished for all onsite employees.

1.7.3 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new feature of work, training will be provided to all affected employees to include a review of the AHA to be implemented.

1.8 ACCIDENT PREVENTION PLAN (APP)

The Contractor shall use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Preparation of Accident Prevention Plan". Where a paragraph or subparagraph element is not applicable to the work to be performed indicate "Not Applicable" next to the heading. Specific requirements for some of the APP elements are described below at paragraph 1.8.1. The APP shall be job-specific and shall address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. The APP shall include an executed POD Form 248-R rev (1 Jun 98), Accident Prevention Program, Administrative Plan.

Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated CSP and/or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the safety coordination meeting for acceptance. Work cannot proceed without an accepted APP. The Contracting Officer reviews and comments on the Contractor's submitted APP and accepts it when it meets the requirements of the contract provisions.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSSHO and quality control manager. Should any unforeseen hazard become evident during the performance of work, the project superintendent shall inform the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, all necessary action shall be taken by the Contractor to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment.

Copies of the accepted plan will be maintained at the resident engineer's office and at the job site. The APP shall be continuously reviewed and amended, as necessary, throughout the life of the contract. Unusual or

high-hazard activities not identified in the original APP shall be incorporated in the plan as they are discovered.

1.8.1 EM 385-1-1 Contents

In addition to the requirements outlined in Appendix A of USACE EM 385-1-1, the following is required:

- a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSS, CHSTs. The duties of each position shall be specified.
- b. Qualifications of competent and of qualified persons. As a minimum, competent persons shall be designated and qualifications submitted for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.
- c. Confined Space Entry Plan. Develop a confined space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)
- d. Health Hazard Control Program. The Contractor shall designate a competent and qualified person to establish and oversee a Health Hazard Control Program in accordance with USACE EM 385-1-1, Section 6. The program shall ensure that employees, on-site Government representatives, and others, are not adversely exposed to chemical, physical and biological agents and that necessary controls and protective actions are instituted to ensure health.
- e. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. The plan shall be submitted 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.c.18.
- f. Alcohol and Drug Abuse Plan
 - (1) Describe plan for random checks and testing with pre-employment screening in accordance with the DFAR Clause

subpart 252.223-7004, "Drug Free Work Force."

(2) Description of the on-site prevention program

g. Fall Protection and Prevention (FP&P) Plan. The plan shall be site specific and address all fall hazards in the work place and during different phases of construction. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m (6 feet). A qualified person for fall protection shall prepare and sign the plan. The plan shall include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Fall Protection and Prevention Plan shall be revised every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. The accepted Fall Protection and Prevention Plan shall be kept and maintained at the job site for the duration of the project.

The Fall Protection and Prevention Plan shall be included in the Accident Prevention Plan (APP).

h. Training Records and Requirements. List of mandatory training and certifications which are applicable to this project (e.g. explosive actuated tools, confined space entry, fall protection, crane operation, vehicle operator, forklift operators, personal protective equipment); list of requirements for periodic retraining/certification; outline requirements for supervisory and employee safety meetings.

1.8.2 Plan Acceptance

The Contractor shall not commence physical work at the site until the plan has been accepted by the Contracting officer, or his authorized representative. In developing and implementing its Accident Prevention Plan, the Contractor is also responsible for reviewing Section 1 of the most current edition of U.S. Army Corps of Engineers Safety and Health Requirement Manual EM 385-1-1.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be prepared using POD Form 184-R, rev 16 Oct 98. Submit the AHA for review at least 15 calendar days prior to the start of each feature of work. Format subsequent AHA as amendments to the APP. An AHA will be developed by the Contractor for every operation involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or subcontractor is to perform work. The analysis must identify and evaluate hazards and outline the proposed methods and techniques for the safe completion of each feature of work. At a minimum, define activity being performed, sequence of work, specific safety and health hazards anticipated, control measures (to include personal protective equipment) to eliminate or reduce each hazard to acceptable levels, equipment to be used, inspection requirements, training requirements for all involved, and the competent person in charge of that feature of work. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the

appropriate fall protection methods used. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include requirements for safeguarding excavations. An activity requiring an AHA shall not proceed until the AHA has been accepted by the Contracting Officer's representative and a meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activity, including on-site Government representatives. The Contractor shall document meeting attendance at the preparatory, initial, and follow-up phases of quality control inspection. The AHA shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Activity hazard analyses shall be updated as necessary to provide an effective response to changing work conditions and activities. The on-site superintendent, site safety and health officer and competent persons used to develop the AHAs, including updates, shall sign and date the AHAs before they are implemented.

1.10 DISPLAY OF SAFETY INFORMATION

Within 1 calendar days after commencement of work, erect a safety bulletin board at the job site. The following information shall be displayed on the safety bulletin board in clear view of the on-site construction personnel, maintained current, and protected against the elements and unauthorized removal:

- a. Map denoting the route to the nearest emergency care facility.
- b. Emergency phone numbers.
- c. Copy of the most up-to-date APP.
- d. Current AHA(s).
- e. OSHA 300A Form.
- f. OSHA Safety and Health Protection-On-The-Job Poster.
- g. Confined space entry permit.
- h. Hot work permit.
- i. A sign indicating the number of hours worked since last lost workday accident.
- j. Safety and Health Warning Posters.

1.11 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.12 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.13 REPORTS

1.13.1 Accident Reports

a. All injuries, illness, and property damage, regardless of severity or magnitude are reportable. Reports shall be prepared on POD Form 265R and shall be submitted to the Contracting Officer no later than the end of the business day on which the incident occurred.

b. For recordable injuries and illnesses, and property damage accidents resulting in at least \$2,000 in damages, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the USACE Accident Report Form 3394 and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.13.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000. Information shall include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.13.3 Monthly Exposure Reports

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.13.4 Regulatory Citations and Violations

Contact the Contracting Officer immediately of any OSHA or other regulatory agency inspection or visit, and provide the Contracting Officer with a copy

of each citation, report, and contractor response. Correct violations and citations promptly and provide written corrective actions to the Contracting Officer.

1.13.5 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix H and as specified herein with Daily Reports of Inspections.

1.14 HOT WORK

Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Federal Fire Department. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

- a. Oil painting materials (paint, brushes, empty paint cans, etc.), and all flammable liquids shall be removed from the facility at quitting time. All painting materials and flammable liquids shall be stored outside in a suitable metal locker or box and will require re-submittal with non-hazardous materials.
- b. Accumulation of trays, paper, shavings, sawdust, boxes and other packing materials shall be removed from the facility at the close of each workday and such material disposed of in the proper containers located away from the facility.
- c. The storage of combustible supplies shall be a safe distance from structures.
- d. Area outside the facility undergoing work shall be cleaned of trash, paper, or other discarded combustibles at the close of each workday.
- e. All portable electric devices (saws, sanders, compressors, extension chord, lights, etc.) shall be disconnected at the close of each workday. When possible, the main electric switch in the facility shall be deactivated.
- f. When starting work in the facility, Contractors shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DEPARTMENT IMMEDIATELY.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

The Contractor shall provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of 25 mm (one inch) in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 1.52 m (5 feet).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

The Contractor shall comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard shall prevail.

3.1.1 Hazardous Material Use

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material. Any work or storage involving hazardous chemicals or materials must be done in a manner that will not expose Government or Contractor employees to any unsafe or unhealthful conditions. Adequate protective measures must be taken to prevent Government or Contractor employees from being exposed to any hazardous condition that could result from the work or storage. The Prime Contractor shall keep a complete inventory of hazardous materials brought onto the work-site. Approval by the Contracting Officer of protective measures and storage area is required prior to the start of the work.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the

Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply in writing for utility outages at least 60 days in advance. Special requirements for outage requests are on the contract drawings. Once approved, and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the Contracting Officer and the DPW to review the scope of work and the procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

The Contractor shall establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. The program shall include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and escape procedures.

3.3.1 Training

The Contractor shall institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, the Contractor shall provide training for each employee who might be exposed to fall hazards. A competent person for fall protection shall provide the training. Training requirements shall be in accordance with USACE EM 385-1-1, section 21.A.16.

3.3.2 Fall Protection Equipment

The Contractor shall enforce use of the fall protection equipment designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is on a surface 1.8 m(6 feet) or more above lower levels. Fall protection systems such as guardrails, personnel fall arrest system, safety nets, etc., are required when working within 1.8m (6 feet) of any leading edge. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.I. and 05.J. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500,

Subpart M and USACE EM 385-1-1.

3.3.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ANSI Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.3.3 Fall Protection for Roofing Work

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 1.8 m (6 feet) of an edge, on low-slope roofs, personnel shall be protected from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 1.8 m (6 feet) from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep Roofs: Work on steep roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.3.4 Safety Nets

If safety nets are used as the selected fall protection system on the project, they shall be provided at unguarded work places, leading edge work or when working over water, machinery, dangerous operations or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, fall arrest systems or restraint/positioning systems are impractical. Safety nets shall be tested immediately after installation with a drop test of 181.4 kg (400 pounds) dropped from the same elevation a person might fall, and every six months thereafter.

3.3.5 Existing Anchorage

Existing anchorages, to be used for attachment of personal fall arrest equipment, shall be certified (or re-certified) by a qualified person for fall protection in accordance with ANSI Z359.1. Existing horizontal lifeline anchorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.3.6 Horizontal Lifelines

Horizontal lifelines shall be designed, installed, certified and used under the supervision of a qualified person for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.3.7 Guardrail Systems

Guardrails shall consist of top and mid-rails, post and toe boards. The top edge height of standard railing must be 42 inches plus or minus 3 inches above the walking/working level. When mid-rails are used, they must be installed at a height midway between the top edge of the guardrail system and the walking/working level. Posts shall be placed no more than 8 feet apart (29 CFR 1926.500 and USACE EM 385-1-1).

3.3.8 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. A Rescue and Evacuation Plan shall be prepared by the contractor and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. The Rescue and Evacuation Plan shall be included in the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.4 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access to scaffold platforms greater than 6 m (20 feet) in height shall be accessed by use of a scaffold stair system. Vertical ladders commonly provided by scaffold system manufacturers shall not be used for accessing scaffold platforms greater than 6 m (20 feet) in height. The use of an adequate gate is required. Contractor shall ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded.

Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Work platforms shall be placed on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.4.1 Stilts

The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is prohibited.

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

- a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
- c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Equipment and Mechanized Equipment

- a. Equipment shall be operated by designated qualified operators. Proof of qualifications shall be kept on the project site for review.
- b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Such additional safety precautions or requirements shall be incorporated into the AHAs.
- c. Equipment and mechanized equipment shall be inspected in accordance with manufacturer's recommendations for safe operation by a competent person prior to being placed into use.
- d. Daily checks or tests shall be conducted and documented on equipment and mechanized equipment by designated competent persons.

3.6 EXCAVATIONS

The competent person for excavations performed as a result of contract work shall be on-site when excavation work is being performed, and shall inspect, and document the excavations daily prior to entry by workers. The competent person must evaluate all hazards, including atmospheric, that may

be associated with the work, and shall have the resources necessary to correct hazards promptly. The competent person shall perform soil classification in accordance with 29 CFR 1926.

3.6.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.6.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 0.061 m (2 feet) of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 30.5 m (100 feet) if parallel within 1.5 m (5 feet) of the excavation.

3.6.3 Utilities with Concrete Slabs

Utilities located within concrete slabs or pier decks, bridges, and the like are extremely difficult to identify. The location must be coordinated with station utility departments in addition to a private locating service. Outages on system utilities shall be used in circumstances where concrete chipping, saw cutting, or core drilling is required and utilities are unable to be completely identified.

3.6.4 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacturer tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding shall have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.6.5 Trenching Machinery

Trenching machines with digging chain drives shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file at the project site.

3.7 ELECTRICAL

3.7.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

3.7.2 Portable Extension Cords

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered and protected from damage. All damaged extension cords shall be immediately removed from service. Portable extension cords shall meet the requirements of NFPA 70.

3.8 WORK IN CONFINED SPACES

The Contractor shall comply with the requirements in Section 06.I of USACE EM 385-1-1 and OSHA 29 CFR 1910.146. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.05 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

- c. Ensure the use of rescue and retrieval devices in confined spaces greater than 1.5 m (5 feet) in depth. Conform to Sections 06.I.09, 06.I.10 and 06.I.11 of USACE EM 385-1-1.
- d. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.
- e. Include training information for employees who will be involved as entrants and attendants for the work. Conform to Section 06.I.06 of USACE EM 385-1-1.
- f. Daily Entry Permit. Post the permit in a conspicuous place close to the confined space entrance.

3.9 CRYSTALLINE SILICA

Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with OSHA regulations, such as 29 CFR 1910.94, and USACE EM 385-1-1, Appendix C. The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

3.10 HOUSEKEEPING

3.10.1 Clean-Up

All debris in work areas shall be cleaned up daily or more frequently if necessary. Construction debris may be temporarily located in an approved location, however garbage accumulation must be removed each day.

3.10.2 Falling Object Protection

All areas must be barricaded to safeguard employees. When working overhead, Barricade the area below to prevent entry by unauthorized employees. Construction warning tape and signs shall be posted so they are clearly visible from all possible access points. When employees are working overhead all tools and equipment shall be secured so that they will not fall. When using guardrail as falling object protection, all openings shall be small enough to prevent passage of potential falling objects.

-- End of Section --

The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 DEFECTIVE (NONCOMPLYING) WORK

The Contractor shall not build upon or conceal defective work. The effectiveness of the Quality Control system shall be judged on the basis of defective work being promptly recognized, the Contractor's production staff advised and immediate corrective action taken. If the Contractor's production staff builds directly upon or over defective work, without making prompt and necessary corrections; and in the process conceals the defective work, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders or corrective action shall be made the subject of a claim for extension of time or additional costs or damages to the Contractor. No payments shall be made for defective work.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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SECTION 01572

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.2 MANAGEMENT

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

1.3 PLAN

A waste management plan shall be submitted within 15 days after [contract award][notice to proceed] and prior to initiating any site preparation work. The plan shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation.
- c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.
- d. Characterization, including estimated types and quantities, of the

waste to be generated.

e. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

f. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.

g. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.

h. Identification of materials that cannot be recycled/reused with an explanation or justification.

i. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

1.4 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.5 COLLECTION

The necessary containers, bins and storage areas to facilitate effective waste management shall be provided and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:

1.5.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing.

1.5.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.5.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.6 DISPOSAL

Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.6.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

1.6.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

1.6.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

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RECYCLED / RECOVERED MATERIALS

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work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

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SECTION 01780

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings.

Drawings showing final as-built conditions of the project. The final CADD as-built drawings shall consist of three sets of electronic CADD drawing files in the specified format, one set of original drawings, three sets of prints of the originals, and one set of the Government accepted working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials.

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan.

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags.

Two record copies of the warranty tags showing the layout and design.

Final Clean-Up.

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall maintain 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a daily basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. At the final inspection or upon beneficial occupancy of the facility by the user, whichever comes first. The Contractor shall provide one of the two sets of working as-built drawings to the COR for turnover with the facility. This set will serve as an advance/interim working set for the occupant of the completed facility; until such time that the final as-built drawings are furnished to them. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked drawings and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement is reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

- b. The location and dimensions of any changes within the building structure.
- c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.
- d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.
- f. Changes or modifications which result from the final inspection.
- g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built drawings.
- h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.
- i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.
- j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.
 - (1) Directions in the modification for posting descriptive changes shall be followed.
 - (2) A Modification Circle shall be placed at the location of each deletion.
 - (3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.
 - (4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).
 - (5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.
 - (6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.
 - (7) The Modification Circle size shall be 12.7 mm diameter

unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with Government accepted working as-built drawings, and adding such additional drawings as may be necessary. These working as-built marked drawings shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned by the Contractor to the Contracting Officer after final acceptance by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of microstation CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished Microstation CADD files and pentable. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

- (1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.
- (2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.
- (3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. All changes to the contract drawing files shall be made on the level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 5 mm high. All other contract drawings shall be marked either "as-built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 10 days after Government acceptance of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue/black-line prints of these drawings for Government review. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of three sets of electronic files on compact disc, read-only memory (CD-ROM), one set of originals, three sets of prints and one set of the Government annotated and accepted working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final acceptance. Failure to submit final as-built drawing files or working as-built marked drawings as specified shall be cause for withholding any payment due the Contractor under this contract. Acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and	Composition and Size	Where Used
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RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA
Serial Number

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled, in accordance with the Contract Clause, WARRANTY OF CONSTRUCTION. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for

extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain in effect throughout the construction period, and during the life of any guaranty required under the Contract Performance Bond, Standard Form 25.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others. After completion of the construction warranty work, charges will be made to the remaining construction warranty funds of expenses which the Government incurred while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government, at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems

- (1) Recreational support.
- (2) Air conditioning leak in part of building, if causing damage.
- (3) Air conditioning system not cooling properly.

Code 1-Doors

- (1) Overhead doors not operational, causing a security, fire, or safety problem.
- (2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors

- (1) Overhead doors not operational.
- (2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical

- (1) Power failure (entire area or any building operational after 1600 hours).
- (2) Security lights
- (3) Smoke detectors

Code 2-Electrical

- (1) Power failure (no power to a room or part of building).
- (2) Receptacle and lights (in a room or part of building).

Code 3-Electrical

Street lights.

Code 1-Gas

- (1) Leaks and breaks.
- (2) No gas to family housing unit or cantonment area.

Code 1-Heat

- (1) Area power failure affecting heat.
- (2) Heater in unit not working.

Code 2-Kitchen Equipment

- (1) Dishwasher not operating properly.
- (2) All other equipment hampering preparation of a meal.

Code 1-Plumbing

- (1) Hot water heater failure.
- (2) Leaking water supply pipes.

Code 2-Plumbing

- (1) Flush valves not operating properly.
- (2) Fixture drain, supply line to commode, or any water pipe leaking.
- (3) Commode leaking at base.

Code 3 -Plumbing

Leaky faucets.

Code 3-Interior

- (1) Floors damaged.
- (2) Paint chipping or peeling.
- (3) Casework.

Code 1-Roof Leaks

Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks

Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)

No water to facility.

Code 2-Water (Hot)

No hot water in portion of building listed.

Code 3-All other work not listed above.

1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

- a. Type of product/material_____.
- b. Model number_____.
- c. Serial number_____.
- d. Contract number_____.
- e. Warranty period_____from_____to_____.
- f. Inspector's signature_____.
- g. Construction Contractor_____.
- Address_____.
- Telephone number_____.
- h. Warranty contact_____.
- Address_____.
- Telephone number_____.
- i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be cleaned. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01900

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SECTION 01900

MISCELLANEOUS PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1001 Asbestos, Tremolite, Anthophyllite, and Actinolite

29 CFR 1926.1101 Asbestos, Tremolite, Anthophyllite, Actinolite

ENGINEERING MANUALS (EM)

EM 385-1-1 U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Organization Plan; G.

Provide a diagram depicting the proposed management organization. The chart shall clearly identify lines of authority and areas of responsibility. Include a narrative description of how the management team will operate, and the specific duties and responsibilities of the key individuals.

The narrative shall describe the Offeror's proposed on-site organization and structure, and shall describe how the Offeror intends to monitor and control timeliness, quality, and safety of

the work at the job site, including the work of any subcontractors on all phases of the contract.

Identify the individuals proposed to fill the key management positions: Project Superintendent, Contractor Quality Control System Manager, Safety Officer. Provide resumes for each individual. Resumes must support the individual's qualifications to perform in the selected position.

Provide copies of letters of direction to each key personnel from an appropriate officer of the company.

Accident Prevention Plan; G.

Activity Hazard Analyses; G.

Phasing and Traffic Control Plans; G.

Proposed phasing and traffic control plans shall be prepared for each road closure by a traffic engineer as indicated on the drawings.

SD-03 Product Data

Equipment Data.

A list of all equipment furnished under this contract. This list shall include, but not be limited to, each piece of equipment with a serial number, and shall include all information shown on the manufacturer's nameplate, so as to positively identify the piece of equipment. This list shall also include the cost of each piece of equipment (less installation costs) F.O.B. construction site. This list shall be furnished as soon as possible after equipment is purchased. The list shall consist of one (1) reproducible and three (3) copies, and shall be furnished to the Contracting Officer not later than thirty (30) calendar days prior to completion of any segment of the contract work that has an incremental completion date.

Recovered Material Report

The Contractor shall provide a report listing all products meeting EPA guidelines for products containing recovered materials and quantity used for this project.

SD-06 Test Reports

Inspection of Existing Conditions.

A written report with color photographs noting the condition of the existing facilities at the time of the inspection. One copy of the report including photographs shall be submitted to the Contracting Officer, prior to construction.

Dust Control; G.

Method(s) of dust control.

Excavation/Trenching Clearance.

Prior to start of any excavation or trenching work, the Contractor shall obtain clearance, in writing, from the appropriate communications agency and base or area engineer. Copies of all correspondence shall be provided the Contracting Officer. Normal coordination time for obtaining the necessary permits is approximately fifteen (15) calendar days. The Contractor shall advise the Contracting Officer promptly when it appears that the normal coordination time will be exceeded.

Condition of Contractor's Operation or Storage Area.

The Contractor shall submit to the Contracting Officer photographs and/or videos depicting the condition of the Contractor's Operation or Storage Area.

SD-07 Certificates

Products Containing Recovered Materials.

The Contractor shall submit manufacturer's certification attesting that product meets or exceeds EPA's recovered material guidelines.

1.3 PROJECT MANAGEMENT ORGANIZATION

1.3.1 General

The Contractor is responsible for ensuring that the contract is adequately staffed to manage all of the work in full accordance and compliance with the contract requirements.

1.3.2 Organization Plan

The contractor shall submit an organization plan describing the organization it intends to structure for managing this contract. The plan shall include lines of authority, position responsibilities, and qualifications of the proposed staff. The project staff shall minimally consist of the following key personnel: Project Superintendent, Contractor Quality Control System Manager, Safety Officer. Each of the individuals selected to fill these positions is subject to acceptance by the Contracting Officer.

1.3.3 Organizational Changes

The Contractor shall maintain the project management staff at full strength at all times. When it is necessary to make changes to the staff, the Contractor shall revise the Organization Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance at least

fourteen (14) calendar days prior to implementation of the changes.

Substitutions for any accepted key personnel must be submitted for review and acceptance by the Contracting Officer prior to the start of work by that individual. The Contractor is informed that the Government will be allowed at least 30 days to respond. Any delays resulting from this process shall be the responsibility of the contractor and shall not be a basis for any equitable contract adjustment.

1.3.4 Project Superintendent

The Project Superintendent shall be responsible for the contractor's overall management and coordination of this contract and shall be the central point of contact with the Government for performance of all work under this contract including warranty. The Project Superintendent shall oversee construction accomplishment, administer all instructions, and answer all questions from the Contracting Officer pertaining to the work during the life of the contract, including the warranty period. The Project Superintendent shall be responsible for the complete coordination of all work in this contract. The Project Superintendent will be responsible for ensuring that adequate internal controls and review procedures are followed in order to eliminate conflicts, errors and omissions, and for ensuring that all technical requirements are met. The Project Superintendent shall be on-site at all times during construction activities and shall be assigned no other duties. Another individual may be designated to temporarily act for the Project Superintendent, however, forty-eight (48) hours advance notice in writing of such change shall be requested to the Contracting Officer, and no change shall be made without prior acceptance by the Contracting Officer.

The Project Superintendent shall have a minimum of 20 years construction experience as a Project Superintendent/Lead Foreman, including 10 years of which shall be as a Project Superintendent responsible for managing and supervising construction projects of similar size and scope.

1.3.5 Contractor Quality Control

To assure compliance with contract requirements, the Contractor shall establish and maintain quality control for materials and work, including design, covered by all sections of the TECHNICAL REQUIREMENTS in accordance with Section 01455 CONTRACTOR QUALITY CONTROL. Records shall be maintained for all operations including sampling and testing.

1.3.6 Safety

1.3.6.1 General

Site activities performed in conjunction with this contract may pose safety hazards that require specialized expertise to effectively address and eliminate. The Contractor shall be responsible for preparing and implementing an effective safety and health program throughout the entire duration of the contract.

1.3.6.2 Accident Prevention Plan (APP)

The contractor shall prepare an Accident Prevention Plan in accordance with the provisions of FAR 52.236-13 (Section 00700) and Section 00800, paragraph S-36.18. The Accident Prevention Plan shall address the contractor's overall safety program for the entire contract. The APP shall consist of the forms and documents listed in Section 00800, S36.18, ACCIDENT PREVENTION PLAN, covering the overall safety considerations for the contract as a whole.

1.3.6.3 Site-Specific Safety and Health Plan (SSHP)

The contractor shall prepare a site-specific safety and health plan addressing the safety aspects specific to the work ordered. Work on a feature of work shall not commence prior to receiving the Contracting Officer's written acceptance of both the contract Accident Prevention Plan and the site-specific safety and health plan.

The SSHP shall be prepared in accordance with the requirements specified in this section and shall comply with all federal, state, and local health and safety requirements, e.g., the Occupational Safety and Health Administration (OSHA) requirements (29 CFR 1910 and 29 CFR 1926) and the U.S. Army Corps of Engineers Safety and Health Requirements Manual (EM 385-1-1). The SSHP shall address those elements that are specific to the feature of work that have potential for negative effects on the safety and health of workers, the public, and other personnel on site.

An Activity Hazard Analysis (AHA), POD Form 184-R, rev 16 Oct 98, shall be submitted for all phases of construction specific to the feature of work and worksite. Work on a construction phase cannot begin until the AHA is submitted and accepted.

The SSHP shall identify the individual responsible for jobsite safety. This individual shall be present at the jobsite at all times during construction. Copies of the accepted SSHP and Accident Prevention Plan shall be available at the jobsite at all times. All workers shall know the location of these plans. All workers shall receive a safety briefing covering applicable sections of these plans prior to the start of construction.

Daily safety and health inspections shall be conducted to determine if site operations are conducted in accordance with the accepted SSHP and contract requirements. Results and observations made during these inspections shall be noted in the contractor's daily report.

1.3.6.4 Safety Officer

The Safety Officer shall have direct responsibility for the overall management of the contractor's Safety Program for the entire contract, as required by the US Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, and other applicable safety standards. This individual shall have a minimum of five (5) years experience in safety on Department of Defense construction projects similar in size and scope to this contract. All members of the safety staff are subject to review and acceptance by the Contracting Officer. The Safety Officer shall have no

other duties.

1.4 AS-BUILT DRAWINGS

As-built drawings shall be in accordance with Section 01780 CLOSEOUT SUBMITTALS.

1.5 DUST CONTROL

Dust control shall be in accordance with Section 02220 DEMOLITION.

1.6 PROTECTION

The Contractor shall take all necessary precautions to insure that no damages to private or public property will result from his operations. Any such damages shall be repaired or property replaced by the Contractor in accordance with the CONTRACT CLAUSES entitled "PERMITS AND RESPONSIBILITIES" and "PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS", without delay, and at no cost to the Government.

1.6.1 Warning Signs and Barricades

The Contractor shall be responsible for posting warning signs or erecting temporary barricades to provide for safe conduct of work and protection of property.

1.6.2 Protection of Grassed and Landscaped Areas

The Contractor's vehicles shall be restricted to paved roadways and driveways. Vehicles shall not be driven or parked on grassed and/or landscaped areas except when absolutely necessary for the performance of the work and approved in advance by the Contracting Officer. Grassed or landscaped areas damaged by the Contractor shall be restored to their original condition without delay and at no cost to the Government.

1.6.3 Protection of Trees and Plants

Where necessary, tree branches and plants interfering with the work may be temporarily tied back by the Contractor to permit accomplishment of the work in a convenient manner, so long as they will not be permanently damaged thereby. If this is not feasible, the Contracting Officer may prune them, subject to written approval.

1.6.4 Protection of Building From the Weather

The interior of the building and all materials and equipment shall be protected from the weather at all times.

1.7 RESTORATION WORK

Existing conditions or areas damaged or disturbed by the Contractor's operations shall be restored to their original condition, or near original condition as possible, within 14 days of damage or disturbance, to the

satisfaction of the Contracting Officer.

1.8 REMOVAL AND DISPOSAL

The Contractor shall salvage or recycle waste to the maximum extent practical as it relates to the capabilities of local industries. A record of the quantity of salvaged or recycled materials shall be maintained by the Contractor during the length of the project and submitted to the Contracting Officer at acceptance of the project. Quantities shall be recorded in the unit of measure of the industry. Reuse of materials on the site shall be considered a form of recycling. An example of such reuse would be the use of acceptable excavated materials as fill.

1.8.1 Title to Materials

Title to all materials and equipment to be removed, except as indicated or specified otherwise, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after the Contractor's receipt of notice to proceed. Items indicated to be removed shall be removed and disposed of by the Contractor outside the limits of Government-controlled property at the Contractor's responsibility and expense before the completion and final acceptance of the work and such materials shall not be sold on the site.

1.8.2 Rubbish and Debris

Rubbish and debris shall be removed from Government-controlled property daily unless otherwise directed, so as not to allow accumulation inside or outside the building. Materials that cannot be removed daily shall be stored in areas designated by the Contracting Officer

1.9 INTERFERENCE WITH GOVERNMENT OPERATIONS

The Contractor shall establish work procedures and methods to prevent interference with existing operations within or adjacent to the construction area. Free passage into adjoining or adjacent buildings not in the contract will not be permitted except as approved by the Contracting Officer. Procedures and methods shall also provide for safe conduct of work and protection of property that is to remain undisturbed.

1.9.1 Coordination

The Contractor shall coordinate all work with the Contracting Officer to minimize interruption and inconvenience to the occupants or to the Government. Scheduling and programming of work will be established during the pre-construction conference.

1.9.2 Materials and Equipment

All materials and equipment required to complete the project shall be on hand before work is started.

1.9.3 Utilities and Facilities

All utilities and facilities within the area shall remain operable and shall not be affected by the Contractor's work, unless otherwise approved in writing in advance by the Contracting Officer.

1.9.4 Staking and Flagging Existing Utilities

The Contractor, prior to start of any excavation or trenching work, shall verify the location of all utility lines shown on the drawings which are within the areas of work, and shall mark, stake, or flag each utility line along trench alignments and under areas of excavation under this project, as approved. Existing utility lines shall be located by walking trench alignments with approved equipment for locating underground pipes and cables. Utility lines so located shall be noted on the drawings.

1.10 CONTRACTOR'S OPERATIONS OR STORAGE AREA

At the request of the Contractor, an open operations or storage area will be made available within the installation, the exact location of which will be determined by the Government. The Contractor shall be responsible for the security necessary for protection of his equipment and materials, and shall maintain the area free of debris. No rusty or unsightly materials shall be used for providing the secure measure and such measure shall be erected in a workmanlike manner. Before any construction commences on establishing the operation/storage area, Contractor shall take photographs and/or videos of the site in order to establish the original conditions of the site. A duplicate set shall be made and submitted to the Government for its files. Upon completion and prior to the final acceptance of the contract work, the Contractor shall restore the area to its original condition.

1.11 GOVERNMENT PROJECT OFFICE

The Contractor shall provide, for use by Government supervisory and inspection personnel, a job-site office space with a floor area not less than 1000 square feet, with minimum once-per-week janitorial service. This office space may be within the Contractor's project office building if adjacent to the job site and if separated by a solid partition; otherwise a separate facility, adjacent to the job site, shall be provided. The office shall be provided with windows and screens, air conditioning to maintain not more than 22 degrees C, electricity, wall outlets, ceiling lights, (4) telephones and (3) cellular phones, (4) office desks with drawers, (10) layout tables, (10) ergonomic chairs, (10) legal-size five-drawer locking file cabinets, (3) 3-shelf bookcase, (3) plan racks, (1) fire extinguisher, and (4) computers.

Provide potable drinking water and temporary toilet facilities for use by Government personnel only. Contractor's copier and fax machine shall be available for use by Government personnel. Contractor shall provide (4) vehicle parking spaces for Government personnel at the project office. The cost of utilities including two telephone lines with different telephone numbers (one number for the telephone instrument and one for the modem), air conditioning, and operation and maintenance costs of the Government project office shall be borne by the Contractor. The government will be responsible for its long distance calls. Upon completion of the project,

the project office and furnishings shall be removed and disposed of by the Contractor.

1.11.1 Computer Requirements

The Contractor shall provide computers for use by Government personnel assigned to this contract. These computers shall be Dell Optiplex GX260 or approved equal (proposed "equal" systems require approval by the Government prior to contract award), minimally configured as follows:

Feature	Requirement
OptiPlex GX260 Small Minitower Memory:	Pentium ® 4 Processor, 2.40GHz, 533FSB, 512K Cache, Intel Gigabit NIC, 1.0GB DDR Non-ECC SDRAM (2DIMMs)
Keyboards:	Dell PS/2 Keyboard in Gray, No Hot Keys
Monitors:	Dell 17 inch M782 flat CRT color monitor (16.0 viewable)
Video Boards:	32MB, ATI, Radeon™ 7500
Boot Hard Drives:	40GB EIDE 7200RPM
Card Reader:	5.25 inch PCMCIA Reader with Required PCI Controller Card
Floppy Drives:	Internal 1.44MB 3.5 Inch Floppy Drive
Operating System(s):	Windows ® 2000 Professional, SP3 with CD using NTFS
Mouse.	Microsoft PS/2 2-Button IntelliMouse with Scroll
Network Adapters (NICs):	Integrated Intel Gigabit (10/100/1000) with Alert Standards Format
Modems:	Dell V.92 PCI Data/Fax Controllerless Modem for Windows
1st Removable Media and DVD+RW Options:	48X CD-RW/DVD Combo, with Roxio Easy CD Creator™ and DVD Decode
Audio Solutions	Integrated Sound Blaster Compatible
Speakers:	Harman Kardon 206 Speakers
Documentation:	Resources CD contains Diagnostics and Driver for Dell OptiPlex Systems
Additional Hard Drive or ZIP Drive:	Zip 250 Disk Drive
Energy Star Label:	Energy Star Label
Hardware Support Services:	3Yr Same Day 4Hr Response Parts + Onsite Labor (M-F 8am-6pm)
Optional Support Services	Gold Technical Support, OptiPlex, 3 Years
Installation Support:	No Installation
Mouse Pad:	Mouse Pad
Power Protection:	Surgemaster Gold 9 outlet
Additional Software:	Microsoft Office 2000 Adobe Acrobat 5.0

The Contractor shall have delivered all required computer hardware and software directly to the Government Project Office in factory-sealed, unopened boxes. Any boxes delivered with damaged or tampered seals will be

rejected by the Government and shall be replaced by the Contractor at no additional cost to the Government. The Government will perform set up of the computers in the Government Project Office.

The Contractor shall provide all software licenses and software updates for the duration of the contract. Hardware shall be provided with a 3-year manufacturer's onsite maintenance contract. Should the construction contract last longer than 3 years, at the end of the maintenance contract, the Contractor shall provide new computers, similar to the above, except configured to the standard at that time. The Government will provide specifications for replacement workstations and hardware.

At the end of the construction contract, the Government will turn over all contractor-provided hardware and software to the Contractor. Hard drives will be wiped clean of all software, including the operating system.

1.11.1.1 Other Devices (minimum requirements)

Printer: Hewlett-Packard Laserjet 5100TN or 5100DTN or approved equal (must be HP PCL compatible), Digital Camera: Kodak LS443 with additional 256 MB memory card, or approved equal.

1.11.1.2 Connectivity Requirements

The Government Project Office shall be provided with one high speed internet connection (RoadRunner™ or DSL) with a minimum download speed of 3 Mbps and a minimum upload speed of 1.5 Mbps and static IP address.

1.11.1.3 Networking Requirements

The Government Project Office shall be configured with a local area network that includes a hub with a minimum of five (5) ports. Wiring shall be CAT5 twisted pair cabling terminated with RJ-45 connectors, which will run from the cable-modem/hub to each of the workstations and/or other devices.

1.12 WORKING DIRECTIVES

1.12.1 Working Hours

All work shall be performed between the hours of 0730 to 1600 HST, Monday through Friday. No work shall be accomplished on Saturdays, Sundays, and all federal holidays, without written permission from the Contracting Officer. Such written permission shall be available at the jobsite at all times during construction.

1.13 COMMERCIAL TELEPHONE SERVICE LINES

Availability of existing commercial telephone service lines are extremely limited and/or non-existent. Contractor shall coordinate with Verizon Hawaii to verify the extent of commercial telephone service lines available and what actions may be necessary to obtain said service in the magnitude required to satisfy its operational requirements. Notwithstanding the actual level of commercial telephone service lines available, the Contractor shall be responsible for all costs and necessary actions.

1.14 INSPECTION

1.14.1 Final Inspection and Acceptance

The Contractor shall give the Contracting Officer, a minimum of fourteen (14) calendar days advance notice prior to final inspection for acceptance by the Contracting Officer. The Contractor upon notification by the Contracting Officer shall promptly and satisfactorily correct all deficiencies found on final inspection.

1.15 USE OF PRODUCTS CONTAINING RECOVERED MATERIALS

Recovered materials are materials manufactured from waste material and byproducts that have been recycled or diverted from solid waste. The Contractor shall give preference to products containing recovered material when price, performance, and availability meet project requirements. A listing of products, including the recommended recovered material content, is provided by the Environmental Protection Agency at <http://www.epa.gov/cpg/products.htm>. Only those products having recovered material content equal to or greater than EPA guidelines shall be used to meet this requirement.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

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SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990) Safety Requirements for Demolition Operations

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K (1997) Containers for Recovered Fluorocarbon Refrigerants

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

40 CFR 82 Protection of Stratospheric Ozone; Refrigerant Recycling

49 CFR 173.301 Shipment of Compressed Gas Cylinders

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (June 2000) Storage and Handling of Liquefied and Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M Requisitioning and Issue Procedures

MIL-STD-129 (Rev. N) Marking for Shipment and Storage

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the

Contracting Officer. The work includes demolition of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

SD-07 Certificates

Demolition plan; G

Notifications; G

Notification of Demolition and Renovation forms; G

Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started.

SD-11 Closeout Submittals

Receipts

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

1.4.1 Notifications

Complete and submit Notification of Demolition and Renovation forms to Federal and State authorities and Contracting Officer, postmarked or delivered at least ten working days prior to commencement of work, in accordance with 40 CFR 61-SUBPART M. Complete paragraphs I, II, III.B, III.C (if applicable), VIII, and IX thru XIX of form. Copy of form is attached at end of this section.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.6.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and tone to identify location at existing utilities to remain and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.6.3 Weather Protection

Protect salvageable materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of

exposed areas so as to ensure effectiveness and to prevent displacement.

1.6.4 Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 1.8 m (6 foot) high fence. The fence shall be securely erected a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.6.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.6.6 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Contracting Officer.

1.9 Environmental Protection

The work shall comply with the requirements of Section 01420 ENVIRONMENTAL PROTECTION.

1.10 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.11 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the phasing plan.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Structures

All existing structures indicated for removal shall be completely removed (including foundation and footings). Interior walls, basement slabs and retaining walls and partitions shall also be completely removed. Sidewalks, curbs, gutters and street light bases indicated for removal, shall be completely removed. As-built drawings are attached (attachment #1) for the following buildings:

3-story barracks: 845, 846, 847
1-story dining facility: 855
1 story wood frame structure: T-876
POL/Hazardous materials shed: 1003

As-built drawings are not available for the following bldgs--:
sheds: T-876A, 1 unlabelled storage shed

3.1.2 Utilities and Related Equipment

Existing utilities to remain (e.g. existing communication, electrical, water, sewer, gas, etc.) shall be toned to identify its exact location and protected from vibrations due to demolition and construction operations which could damage the existing utility lines. All repairs to existing utilities to remain which are damaged by Construction operations shall be repaired by the Contractor (at the Contractor's expense) except that damaged communications cables shall be accomplished by the vendor of the damaged line. The Contractor shall be responsible for all costs incurred by the vendor from repairing damaged communication lines resulting from the Contractors' operations. If utility lines are encountered that are not shown on drawings, contact the Contracting Officer for further instructions.

3.1.3 Paving and Slabs

Sawcut and remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated to a depth of 300 mm below existing adjacent or new finish grade, as required. Provide neat sawcuts at limits

of pavement removal as indicated.

3.1.4 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated.

3.1.5 Concrete

Saw concrete along straight lines to a depth of not less than 50 mm. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Holes and depressions left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
- b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.
- c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.7 Air Conditioning Equipment

Remove air conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning equipment and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.8 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.9 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Contractor shall give the locksets to the Contracting Officer after their removal.

3.2 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02300a EARTHWORK.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.3.2 Reuse of Materials and Equipment

Remove and store signs indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Contracting Officer as directed by the Commanding Officer.

3.3.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.4.1 Special Instructions

Each container shall have in it no more than one type of ODS. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number
- c. Type of ODS and pounds of ODS contained
- d. Date of shipment
- e. Naval stock number (for information, call (804) 279-4525).

3.3.4.2 Fire Suppression Containers

Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.5 Transportation Guidance

Shipment of all ODS containers shall be in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, 49 CFR 173.301, and DOD 4000.25-1-M).

3.3.6 Unsalvageable Material

Construction and demolition debris (C&D) that is not recycled/reused either on or off site shall be disposed of in a State of Hawaii permitted municipal landfill. Recycling/reuse shall be governed by applicable solid waste management guidance of the State of Hawaii Department of Health, Solid Waste Management Section.

3.4 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.4.1 Debris and Rubbish

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.5 Pavements

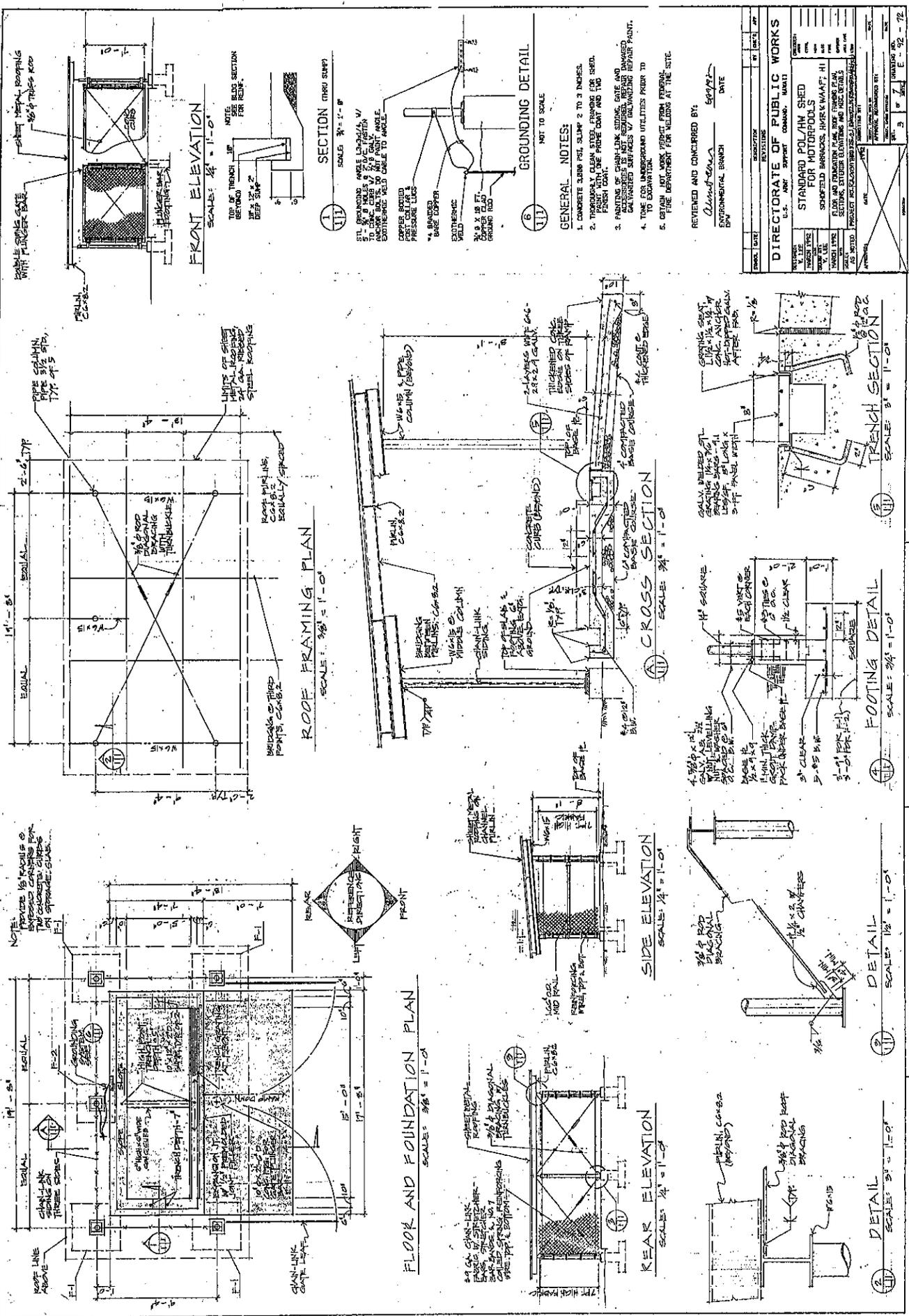
Existing asphalt concrete and concrete pavements designated for removal shall be saw cut to the limits indicated on the drawings and completely removed or crushed and reused as follows:

Unpainted crushed concrete (with all reinforcing steel and other non-concrete materials removed) may be used for base course, select granular and structural fill material (as long as it meets the gradation requirements in the applicable specifications).

Painted concrete (with lead content of less than 0.06% of the dry film by weight) may be crushed and used similarly to unpainted concrete. Contractor shall provide laboratory documentation of the lead content.

Crushed existing AC pavement may be used as select granular and structural fill under AC pavements only (not under concrete pavements, grassed or other (non-AC paved) areas) (if it meets the gradation requirements in the applicable specifications). (Petroleum products in the AC pavement may leach into surrounding soils, thus recycled asphalt shall NOT be placed in non-AC paved areas.)

-- End of Section --



GENERAL NOTES:

1. CONCRETE 3000 PSI, SLUMP 2 TO 3 INCHES.
2. THOROUGHLY CLEAN STEEL FRAMING FOR USED.
3. PAINTS OF ALL KINDS, COATS AND FINISHES TO BE REMOVED FROM ALL SURFACES TO BE PAINTED.
4. TIME FOR UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
5. ALL WORK TO BE PERFECT FROM BEHIND.

REVIEWED AND CONCURRED BY:

Clayton
ENVIRONMENTAL BRANCH

DATE: _____

NO.	DATE	BY	REVISION

DIRECTORATE OF PUBLIC WORKS
U.S. AIR SUPPORT COMMAND, MALDEN

STANDARD POLYHM SHED FOR MOTORPOOLS
SCHAFFIELD BARRACKS, HWY 6 WAAFF, HI

FLOOR AND FRAMING PLAN, SIDE ELEVATION, FRONT ELEVATION, REAR ELEVATION, SECTION, TRENCH SECTION AND FOOTING DETAIL

AS NOTED: PROJECT ARCHITECT/ENGINEER: [unreadable]

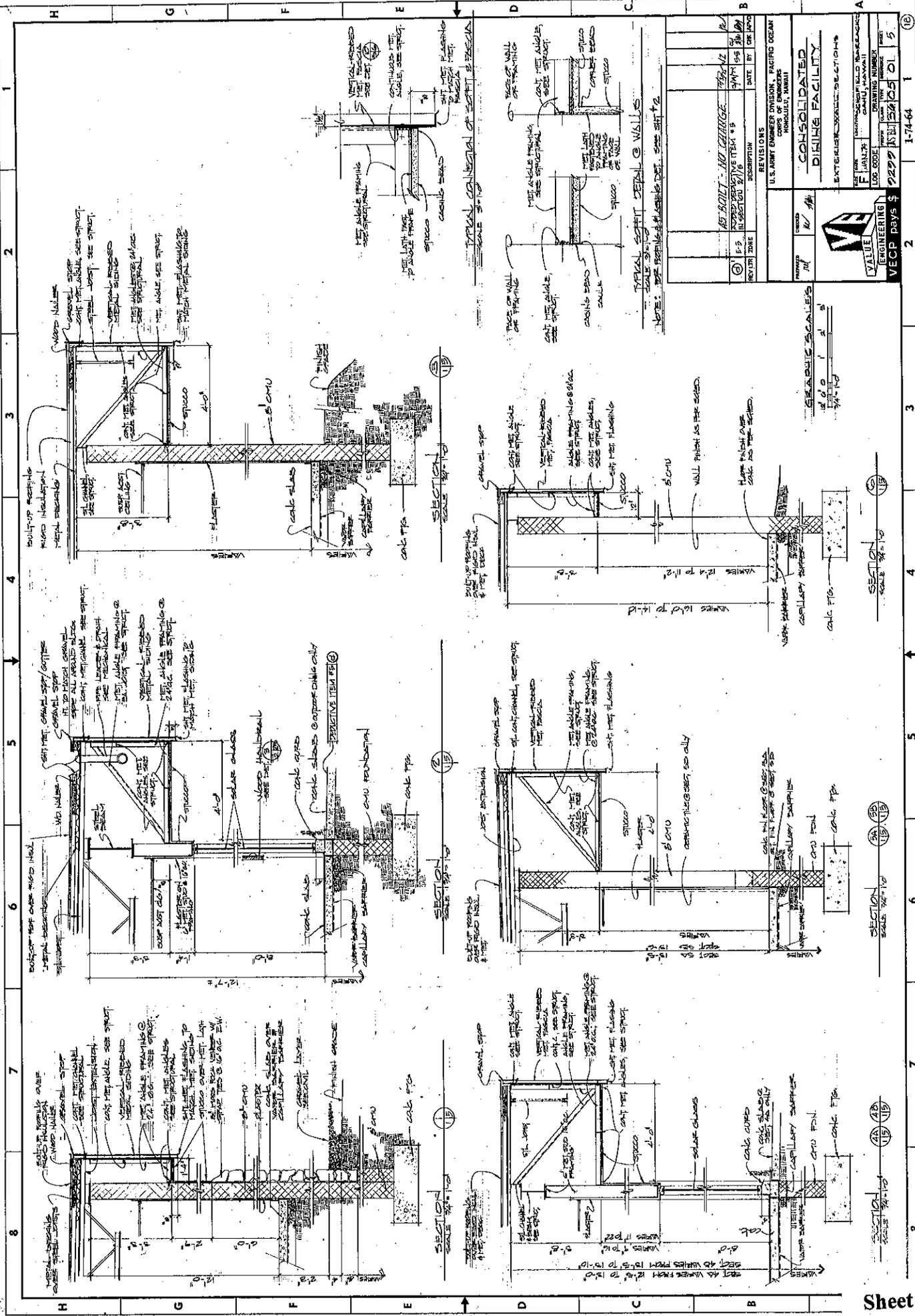
DATE: _____

APPROVED BY: _____

SCALE: E. 1/2" = 1'-0"

E-92-17

AS-BUILT: BLDG 1003



REVISIONS		DATE	BY
1	REVISED	10/10/54	WJ
2	REVISED	10/10/54	WJ
3	REVISED	10/10/54	WJ
4	REVISED	10/10/54	WJ
5	REVISED	10/10/54	WJ

PROJECT: NO. CHANGE
 DRAWING NO. 2115
 SHEET NO. 05
 DATE: 10/10/54

U.S. ARMY ENGINEER DIVISION, PACIFIC OCEAN
 CORPS OF ENGINEERS
 HONOLULU, HAWAII

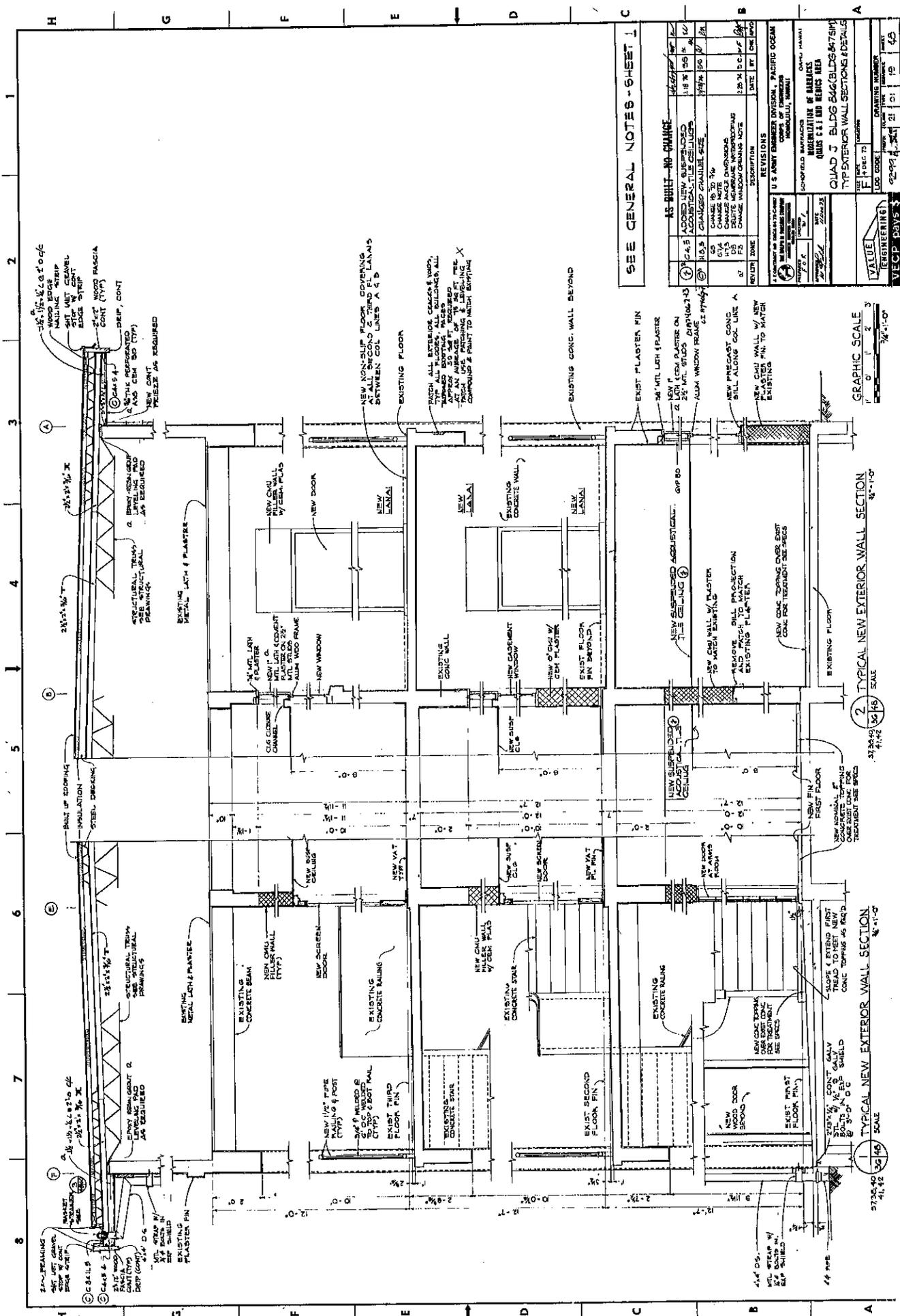
CONSOLIDATED
DINING FACILITY

EXTERIOR WALL SECTIONS

VALUE ENGINEERING
 VECP pays \$ 2222

DRAWING NUMBER: 2115
 SHEET NUMBER: 05
 DATE: 10/10/54

BUDG 855



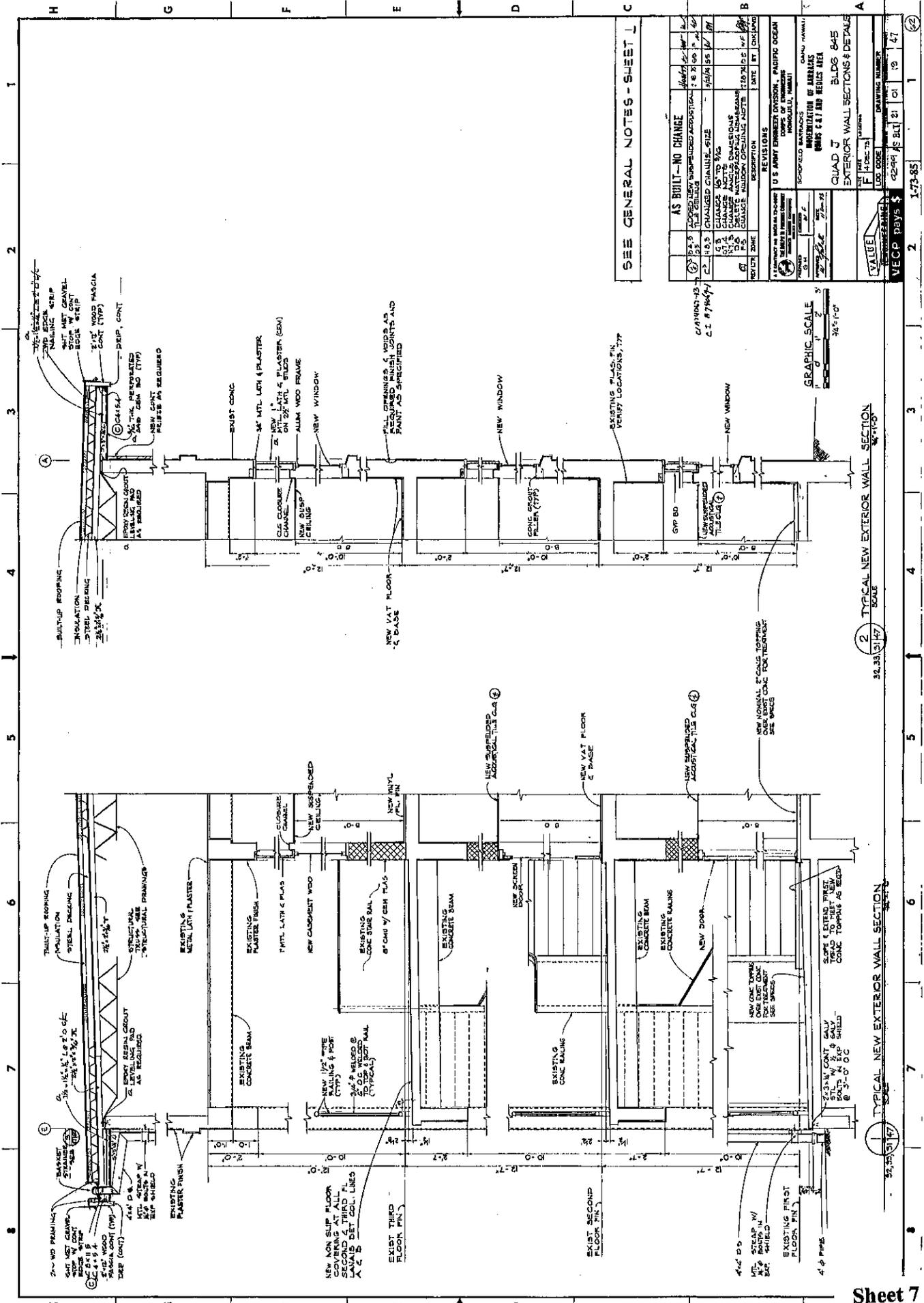
SEE GENERAL NOTES - SHEET 1

NO.	REVISIONS	DATE	BY	CHK
1	AS BUILT - NO CHANGE	1/8/85	W	W
2	ADDED NEW SUSPENDED ACoustICAL TILE CEILING	1/8/85	W	W
3	CHANGED CHANNEL SIZE	1/14/85	W	W
4	CHANGE TO 2\"/>			



BLDG 845, 846, 847

Sheet 5 of 9



SEE GENERAL NOTES - SHEET 1

NO.	DESCRIPTION	DATE	BY
1	AS BUILT - NO CHANGE	10/14/85	BT
2	ADDED NEW SCHEDULED APPROXIMATELY 2' 8" X 6" 1/2"	10/14/85	BT
3	CHANGED CHANNEL SIZE	10/14/85	BT
4	CHANGED WINDOW TYPE	10/14/85	BT
5	CHANGED WINDOW OPERATING STYLE	10/14/85	BT
6	CHANGED WINDOW OPERATING STYLE	10/14/85	BT
7	CHANGED WINDOW OPERATING STYLE	10/14/85	BT
8	CHANGED WINDOW OPERATING STYLE	10/14/85	BT
9	CHANGED WINDOW OPERATING STYLE	10/14/85	BT
10	CHANGED WINDOW OPERATING STYLE	10/14/85	BT

GRAPHIC SCALE
1" = 2'-0"
3/8" = 1'-0"

2 TYPICAL NEW EXTERIOR WALL SECTION
SCALE 3/8" = 1'-0"

2 TYPICAL NEW EXTERIOR WALL SECTION
SCALE 3/8" = 1'-0"

BLDG 845, 846, 847

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PART 3 EXECUTION

3.1 PROTECTION

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3.1.2 Trees, Shrubs, and Existing Facilities

3.1.3 Utility Lines

3.2 CLEARING

3.3 TREE REMOVAL

3.4 PRUNING

3.5 GRUBBING

3.6 DISPOSAL OF MATERIALS

3.6.1 Nonsaleable Materials

-- End of Section Table of Contents --

SECTION 02231

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DELIVERY, STORAGE, AND HANDLING

Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Contracting Officer in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or

otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 40 mm in diameter shall be painted with an approved tree-wound paint.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 38 mm or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 32 mm in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm below the original surface level of the ground within the grading limits indicated. Tree roots and other organic or metallic debris shall be completely removed in new building and pavement areas. Depressions made by grubbing shall be filled with satisfactory material and compacted as indicated in Section 02300a EARTHWORK.

3.6 DISPOSAL OF MATERIALS

3.6.1 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility

-- End of Section --

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GRANULAR TERMITE BARRIER (GTB)

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-- End of Section Table of Contents --

SECTION 02286

GRANULAR TERMITE BARRIER (GTB)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 128	(1988) Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1984; Rev. A) Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 289	(1987) Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM D 1557	(1991) Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Basaltic Termite Barrier Materials.

Submit certification from the material producer that the material supplied complies with the requirements of this Specification.

1.3 STORAGE AND HANDLING

Store and handle the material so as to prevent contamination by dirt or any other matter that can compromise the barrier's effectiveness against termite infestation.

1.4 RELATED WORK

Earthwork for buildings and utilities are specified in Section 02315a EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS and Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

PART 2 PRODUCTS

2.1 GRANULAR TERMITE BARRIER MATERIALS

2.1.1 Basalt Sand

Clean, dry sand material manufactured from crushed basalt rock meeting the following requirements.

A. Material Gradation: ASTM C 136.

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 - 100
No. 10 (2.00 mm)	75 - 95
No. 12 (1.70 mm)	35 - 50
No. 16 (1.18 mm)	0 - 10

b. Specify Gravity: ASTM C 128, 2.80.

c. Silica (SI02) Content: ASTM C 289, 45 percent.

d. Abrasion Loss: After 500 revolutions, 20 percent, when tested in accordance with ASTM C 131.

2.2 EQUIPMENT

Use power driven, vibrating-plate type tampers for large areas and rod-and-plate type hand tampers for small areas such as utility trenches and foundation edges.

2.3 VAPOR BARRIER

As specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

PART 3 EXECUTION

3.1 PREPARATION

Prior to placing material, remove visible plant roots and standing water from the excavated area. Inspect utility trenches to ensure they are sufficiently wide to permit adequate cover under, around, and over pipes and conduit that will be encapsulated with the granular termite barrier. Also inspect the foundation perimeter to assure that there is sufficient room between the sides of excavations and edges of foundations to provide the required barrier depth and width. Do not proceed with the work until discrepancies have been corrected. Insure that pipe and other penetrations through the GTB are clean and free of tape or other wrap that may compromise the GTB's effectiveness.

3.2 PLACEMENT

3.2.1 General

- a. Place material in one lift for thickness of 150 mm (6 inches) or less and in successive lifts of 100 to 150 mm (4 to 6 inches) where the indicated thickness is greater than 150 mm (6 inches). Compact each lift prior to placing successive lifts.
- b. Granular termite barrier material placed directly beneath footings should be compacted to a minimum of 95 percent of maximum dry density, as determined by ASTM D 1557. Granular termite barrier materials which slough into the footing excavation shall be removed or compacted.

3.2.2 Utility Trenches

Place the required depth of material for bedding in trenches prior to placing pipes and conduits. Hand tamp. After placing pipe, bring material up to the top of the pipe, for pipe 75 mm (3 inches) and larger in diameter, and carefully hand tamp the material. Finally, bring up the material to the top of the trench and tamp. For pipes smaller than 75 mm (3 inches) in diameter and for conduit, bring the material up to the top of the trench and tamp.

3.2.3 Excavation Bottom

Place sufficient material in the excavation bottom to provide a barrier of the depth indicated. Rake smooth and machine tamp, giving at least three passes over the entire area. Hand tamp around pipe and conduit risers.

3.2.4 Foundation Edges

After concrete placement and form removal, remove dirt, loose concrete, all wood and other debris from the GTB layer beyond the concrete slab or footing/foundation edge. Bring GTB material up the slab or footing/foundation exterior as one continuous clean GTB layer using hand placement and tamp to form a firm barrier. Install the landscape edging at the outer interface of the GTB layer and finish ground beyond, and complete GTB and seal layer as called for or shown on the drawings.

3.2.5 Perimeter Cap

The perimeter cap shall be used over all exterior granular termite barrier.

The perimeter cap shall be cast-in-place concrete, 100 mm (4 inches) thick, and shaped to slope at 5% away from the concrete slab or foundation/footing edge for drainage. The cap shall be reinforced at mid-depth with galvanize welded wire fabric . The cap shall extend over the granular termite barrier by at least 150 mm (6 inches) and be attached to the adjacent foundation a RAWL spike spaced 3 m (10 feet) on centers.

3.3 CLEANUP

After placement of the granular termite barrier is complete, remove surplus sand and gravel materials from the site.

-- End of Section --

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SECTION 02300A

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 - 1.2.2 Unsatisfactory Materials
 - 1.2.3 Cohesionless and Cohesive Materials
 - 1.2.4 Degree of Compaction
 - 1.2.5 Topsoil
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- 1.4 SUBSURFACE DATA
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- 1.6 UTILIZATION OF EXCAVATED MATERIALS

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- 3.2 GENERAL EXCAVATION
 - 3.2.1 Ditches, Gutters, and Channel Changes
 - 3.2.2 Drainage Structures
- 3.3 SELECTION OF BORROW MATERIAL
- 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS
- 3.5 GRADING AREAS
- 3.6 BACKFILL
- 3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS
 - 3.7.1 General Requirements
- 3.8 EMBANKMENTS
 - 3.8.1 Earth Embankments
- 3.9 SUBGRADE PREPARATION
 - 3.9.1 Construction
 - 3.9.2 Compaction
 - 3.9.2.1 Subgrade for Pavements
 - 3.9.2.2 Subgrade for Shoulders
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- 3.14 SUBGRADE AND EMBANKMENT PROTECTION

-- End of Section Table of Contents --

SECTION 02300A

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop

AASHTO T 224 (1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136 (1996a) Sieve Analysis of Fine and Coarse Aggregates

ASTM D 422 (1963; R 1998) Particle-Size Analysis of Soils

ASTM D 1140 (1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D 1556 (1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))

ASTM D 2487 (1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SP-SM, CL, ML, CL-ML, MH. Satisfactory materials for grading shall be comprised of stones less than 200 mm , except for fill material for pavements and railroads which shall be comprised of stones less than 75 mm in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 9.0 mm sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 9.0 mm sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.2.5 Topsoil

a. Topsoil material shall be natural, friable soil representative of productive soils in the vicinity. It shall be obtained from well-drained areas and shall be free from any admixture of foreign matter including but not limited to roots, objects larger than 1 inch in any dimension, toxic substance, and any material or substance that may be harmful to plant growth.

b. Topsoil shall be offsite materials which meet the above requirements for topsoil material or shall be the existing surface soil stripped to 4-inch depth and stockpiled on the site which meet the above requirements. Any surplus topsoil from on-site excavations and grading shall be removed from the site and disposed of outside of Government property at the Contractor's responsibility.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Earthwork.

Procedure and location for disposal of unused satisfactory material. Blasting plan when blasting is permitted. Proposed source of borrow material.

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing.

Within 24 hours of conclusion of physical tests, 5 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing.

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.4 SUBSURFACE DATA

Subsurface soil boring logs are appended to the SPECIAL CONTRACT REQUIREMENTS. The subsoil investigation report may be examined at Design

Branch, Bldg 230, Fort Shafter, HI. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.6 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory and surplus satisfactory material shall be removed from the site and disposed of outside of Government property at the Contractor's responsibility. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 150 millimeters. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site and disposed of outside the limits of Government-controlled property at Contractor's responsibility.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved

for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be removed from the site and disposed of outside of Government property at the Contractor's responsibility. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from well drained off-site areas as approved by the Contracting Officer.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from sources outside the limits of the project site unless prior written approval for an on-site borrow area is obtained. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor shall notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the

excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02630a STORM-DRAINAGE SYSTEM; and Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 200 mm; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.8 EMBANKMENTS

3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic material and rocks with any dimension greater than 75 mm. The material shall be placed in successive horizontal layers of loose material not more than 200 millimeters in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as

necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9 SUBGRADE PREPARATION

3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 150 mm below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 19 millimeter when tested with a 3.6 meter straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.

3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

3.9.2.1 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 90 percent of maximum density for cohesive material and at least 95 percent of maximum density for cohesionless material for at least 150 mm below the pavement structure.

When more than one soil classification is present in the subgrade, the top 150 mm of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.9.2.2 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 90 percentage laboratory maximum density for the full depth of the shoulder.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 50 mm depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 150 mm and graded to the elevations and slopes shown. Topsoil shall not be spread when excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in accordance with ASTM D 1556 and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as

directed by the Contracting Officer. ASTM D 2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.13.1 Fill and Backfill Material Gradation

One test per 100 cubic meters stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D 422.

3.13.2 In-Place Densities

- a. One test per 475 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 235 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
- c. One test per 475 linear meters, or fraction thereof, of each lift of embankment.
- d. One test per 475 linear meters, or fraction thereof, of each lift of embankment or backfill for railroads.

3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

- a. One check test per lift for each 4750 square meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 2350 square meters, of fill or backfill areas compacted by hand-operated machines.
- c. One check test per lift for each 4750 linear meters, or fraction thereof, of embankment or backfill for roads.
- d. One check test per lift for each 4750 linear meters, or fraction thereof, of embankment or backfill for railroads.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 100 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

APPENDIX A
BORING LEGEND AND LOGS

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B1

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 29 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.	
0					FILL	5" Asphalt, 6" Basalt Base Course							
			15			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown					72	39	
			51										
5			70										
			37										
			33										
10					MH								
			22										
15													
			17										
20													
			19										
25						BORING TERMINATED AT 25.0'							
30													
35													
40													

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B2

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 29 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	LL	P.I.
0	XXXX				FILL	5" Asphalt, 6"- 7" Basalt Base Course						
			30			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown						
			48									
5			45									
			90									
			51				30					
10												
					MH							
15			19									
						Weathered basalt cobble from 17.2' to 17.6'						
20			13									
			22									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B3

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 29 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0			12		FILL	ELASTIC SILT AND CORAL GRAVEL - Fill						
			30			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown						
5			112				27					
			54									
			34									
10												
			19		MH							
15												
			R			Weathered basalt cobble from 19.2' to 20.0'						
20												
			17									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B4

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 29 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0					FILL	3" Asphalt, 7" Basalt Base Course						
			17			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown	32					
			37									
5			34									
			60									
10			38									
				MH								
15			48									
20			18									
25			18									
						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B5

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 30 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0					FILL	3" Asphalt, 7" Basalt Base Course						
			10			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown						
			36									
5			26									
			32									
10			79								88	52
			29		MH							
15						Weathered basalt cobble from 16.5' to 17.4'. Elastic silt becoming friable to slightly plastic						
			12									
20												
			16									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B6

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 30 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0					FILL	3" Asphalt, 6" Basalt Base Course						
			6			ELASTIC SILT- Clayey, plastic, moist, medium stiff to hard, reddish-brown to yellowish-brown	29					
			59									
5			32									
			34									
10			34	MH								
			34									
15			24									
20			18									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B7

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 30 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0	XXXX				FILL	1" Asphalt, 8" Coral Gravel Base Course						
			17			ELASTIC SILT- Clayey, plastic, moist, very stiff to hard, reddish-brown to yellowish-brown						
			16									
5			39									
			38									
10												
					MH							
15			89									
20			18									
25			104									65
						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B8

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 29 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.	
0			10			ELASTIC SILT- Clayey, plastic, moist, medium stiff to hard, reddish-brown to yellowish-brown							
			56										
5			54										
			R									67	32
			R										
10					MH								
			37										
15													
			22										
20													
			24										
25						BORING TERMINATED AT 25.0'							
30													
35													
40													

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B9

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 31 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0			22			ELASTIC SILT- Clayey, plastic, moist, stiff to hard, reddish-brown to yellowish-brown Becoming friable to slightly plastic.	35					
			75									
			48									
5			31									
			21									
10					MH							
			19									
15												
			33									
20												
			13									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

PROJECT: FY03 WBR PHASE 2C AND 2D

PROJECT NO.: SB-01-03

BORING NO.: B10

LOCATION: SCHOFIELD BARRACKS

ELEVATION: N.A.

NORTH: N.A.

DEPTH TO WATER: NOT ENCOUNTERED

EAST: N.A.

DATE: 31 JANUARY 2003

LOGGED BY: E. BJORKEN

DEPTH	SOIL SYMBOL	SAMPLES	BLOWS/ FOOT	CORE RECOVERY	USCS	DESCRIPTION	M.C.	% GRAVEL	% SAND	% FINES	L.L.	P.I.
0			12			ELASTIC SILT- Clayey, plastic, moist, stiff to hard, reddish-brown to yellowish-brown Becoming friable to slightly plastic.	34					
			30									
5			29									
			22									
			22									
10					MH							
			17									
15												
			16									
20												
			27									
25						BORING TERMINATED AT 25.0'						
30												
35												
40												

KEY TO SYMBOLS

Symbol Description

Strata symbols



Fill



Elastic silt

Soil Samplers



Auger



Standard penetration test



California sampler

Notes:

1. Exploratory borings were drilled on 31 JANUARY 2003 using a 4-inch diameter continuous flight power auger.
2. No free water was encountered at the time of drilling or when re-checked the following day.
3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.

APPENDIX B
LABORATORY TEST DATA



March 25, 2003
W.O. 3826-20(A)

Mr. Eric Bjorken
U.S. Army Engineering District, Honolulu
Corps of Engineers, Building 200
Attn: CEPOD-CT-P
Fort Shafter, HI 96858-5440

LABORATORY TEST RESULTS
FY03 WHOLE BARRACKS RENEWAL
PHASE 2C/2D, SCHOFIELD BARRACKS
WAHIAWA, OAHU, HAWAII

Dear **Mr. Bjorken**:

In accordance with your request, we have completed the laboratory tests requested. Based on the request, we have completed the following laboratory tests and are transmitting the test results to you for your use.

The laboratory tests performed included the determination of Atterberg Limits, triaxial unconsolidated undrained compression, swell, and California Bearing Ratio (CBR) tests.

Four Atterberg Limits tests (ASTM D 4318) were performed on selected samples of the soils to determine the liquid and plastic limits and to aid in soil classification. Graphic presentation of the test results is provided on Plate 1.

Three Unconsolidated Undrained Triaxial Compression tests (ASTM D 2850) were performed to evaluate the undrained shear strength of the clayey soils. The tests were performed on relatively "undisturbed" soil samples. The applied confining pressure requested was approximately 0.72 to 0.79 kips per square foot (ksf). The test results and stress-strain curves are presented on Plates 2 through 4.

Five swell tests (ASTM D 4546) were performed on three relatively undisturbed samples and two remolded samples with method B. The remolded samples were prepared from the two bulk samples BS#1 and BS#2. The samples were moisturized close to optimum moisture content, cured, and remolded. All the samples were not air-dried before inundation with water. A surcharge pressure close to overburdened pressures ranging from about 0.1 to 1.5 ksf were applied as requested. After the

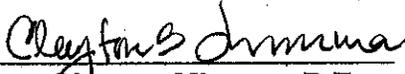
surcharged load was applied, the sample was inundated. The consolidation/swelling was observed until primary consolidation/swell was completed. Results of the swell tests are presented on the Swell Test, Plate 5.

Two California Bearing Ratio (CBR) tests (ASTM D 1883) were performed on the same bulk samples. The samples were moisture-conditioned close to optimum moisture content and cured. The samples were saturated in water for four days to determine swelling condition. CBR penetration tests were performed to determine California Bearing Ratio. Results of the CBR test are presented on Plates 6 and 7.

We appreciate the opportunity to provide our laboratory testing services to you on this project. If you have questions or need additional information, please contact our office.

Respectfully submitted,

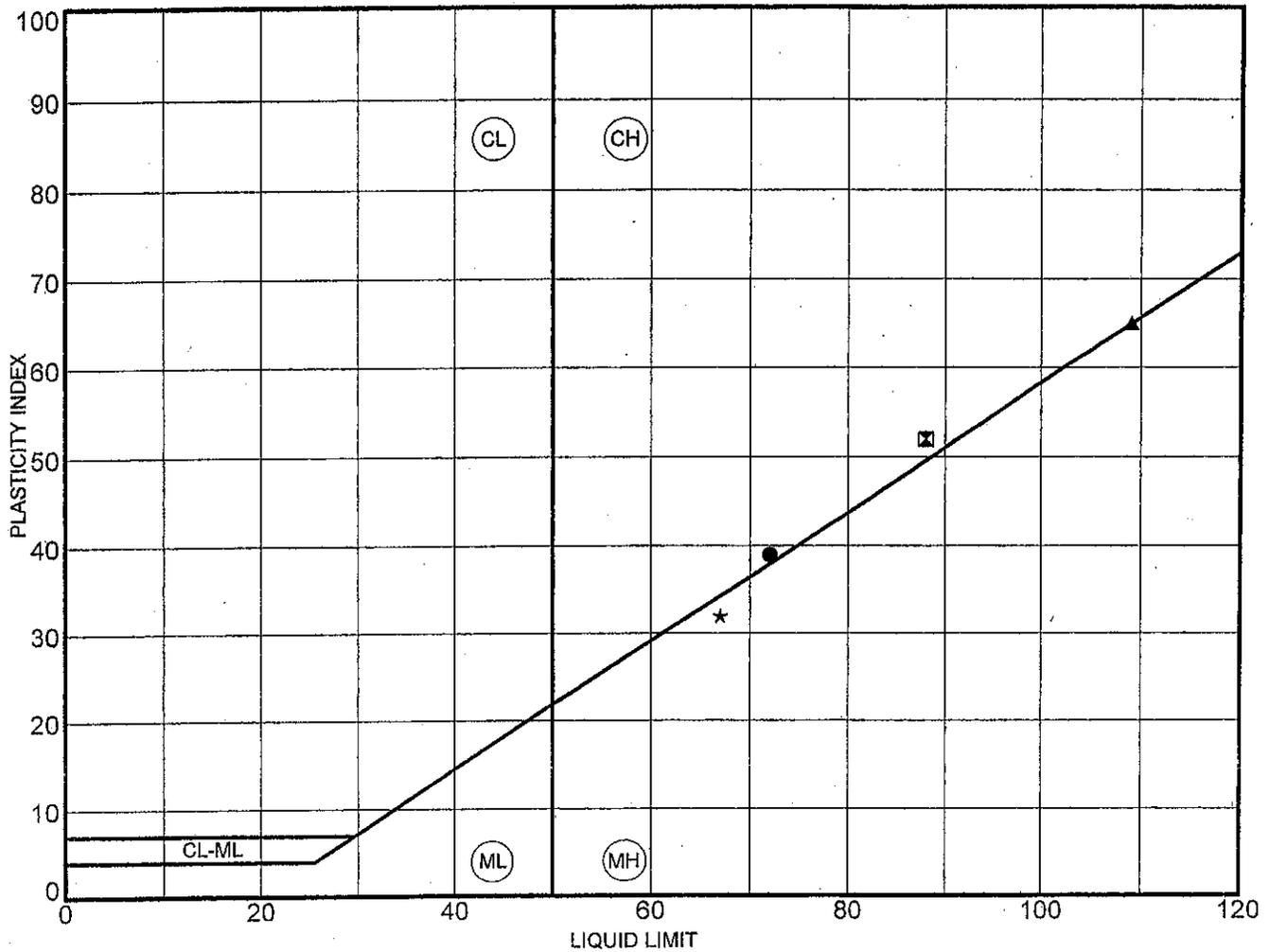
GEOLABS, INC.

By 
Clayton Mimura, P.E.
President

CSM:BC:cj

Attachments: Atterberg Limits Summary, Plate 1
Unconsolidated Undrained Triaxial Compression Test, Plates 2 thru 4
Swell Test, Plate 5
CBR Test, Plates 6 and 7

(u:\03reports\3826-20(A).bc1)



	Sample	Depth (ft)	LL	PL	PI	Description
●	B1	4.0 - 4.5	72	33	39	Reddish brown SILTY CLAY (CH)
⊠	B5	10.0 - 10.5	88	36	52	Tannish brown SILTY CLAY (CH)
▲	B7	24.5 - 25.0	109	44	65	Tannish brown SILTY CLAY (CH)
*	B8	7.4 - 7.9	67	35	32	Reddish brown CLAYEY SILT (MH)

G ATTERBERG 3826-20A.GPJ GEOLABS.GDT 3/24/03



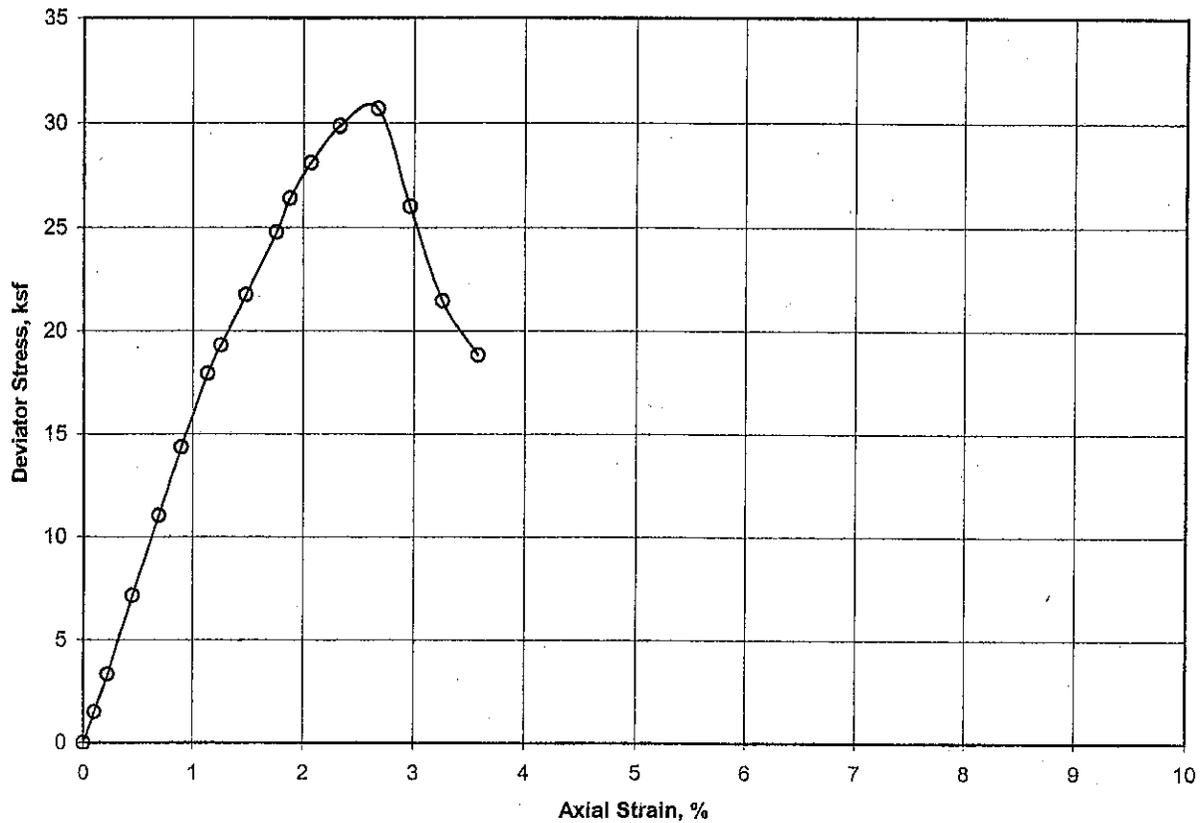
GEOLABS, INC.
 GEOTECHNICAL ENGINEERING
 W.O. 3826-20(A)

ATTERBERG LIMITS TEST RESULTS - ASTM D 4318

FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D
 SCHOFIELD BARRACKS, OAHU, HAWAII

Plate
 1

**UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE
SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850**



LOCATION: B3
 DEPTH: 5 - 5.5 feet
 DESCRIPTION: Brown **SILTY CLAY (CH)**

DRY DENSITY: 97.3 pcf SAMPLE DIAMETER: 2.412 inches
 MOISTURE CONTENT: 26.9 % SAMPLE HEIGHT: 5.802 inches

AT FAILURE

STRAIN RATE = 0.62 %/min.
 CONFINING PRESSURE = 0.72 ksf
 MAX. DEVIATOR STRESS = 30.69 ksf @ 2.7 % STRAIN

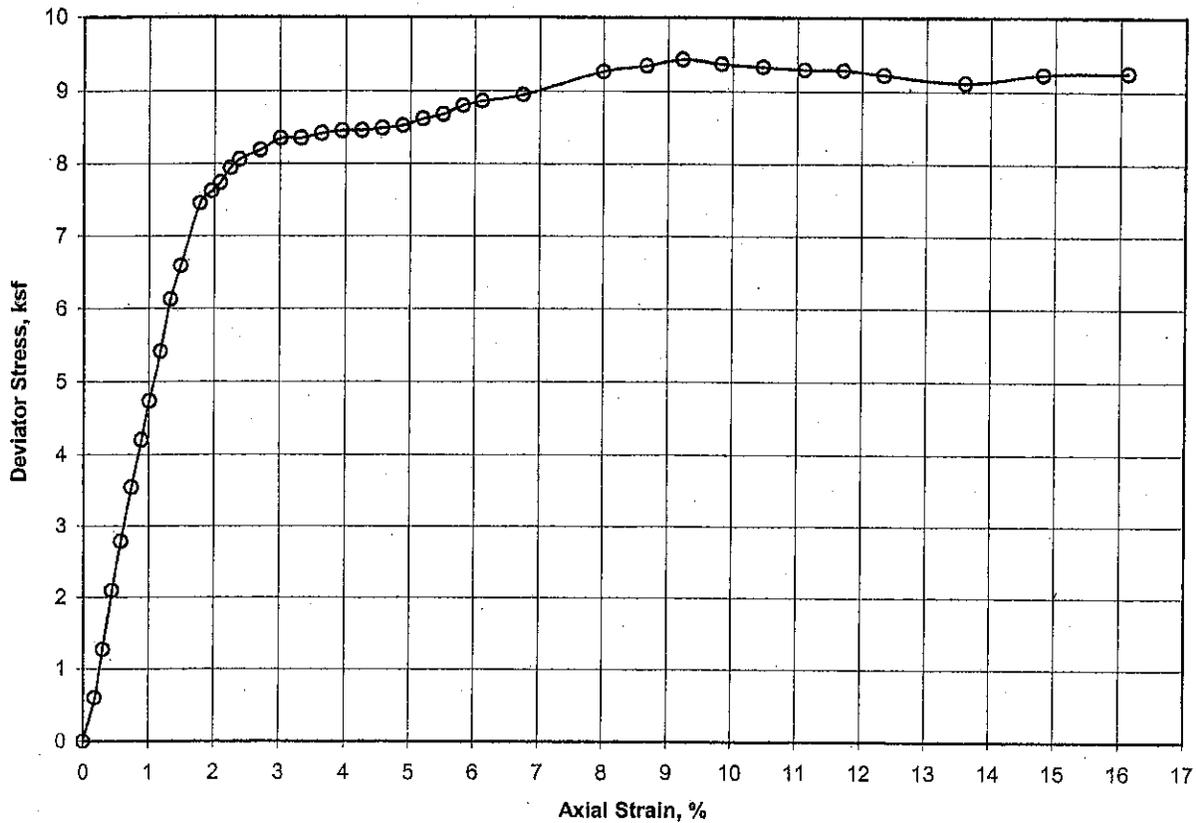
PROJECT:
**FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D,
 SCHOFIELD BARRACKS, OAHU, HAWAII**

UNCONSOLIDATED UNDRAINED
 TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Mar 03	3826-20(A)

**UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE
SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850**



LOCATION: B4
 DEPTH: 8 - 8.5 feet
 DESCRIPTION: Brown **SILTY CLAY (CH)**

DRY DENSITY: 89.8 pcf SAMPLE DIAMETER: 2.399 inches
 MOISTURE CONTENT: 32.0 % SAMPLE HEIGHT: 5.779 inches

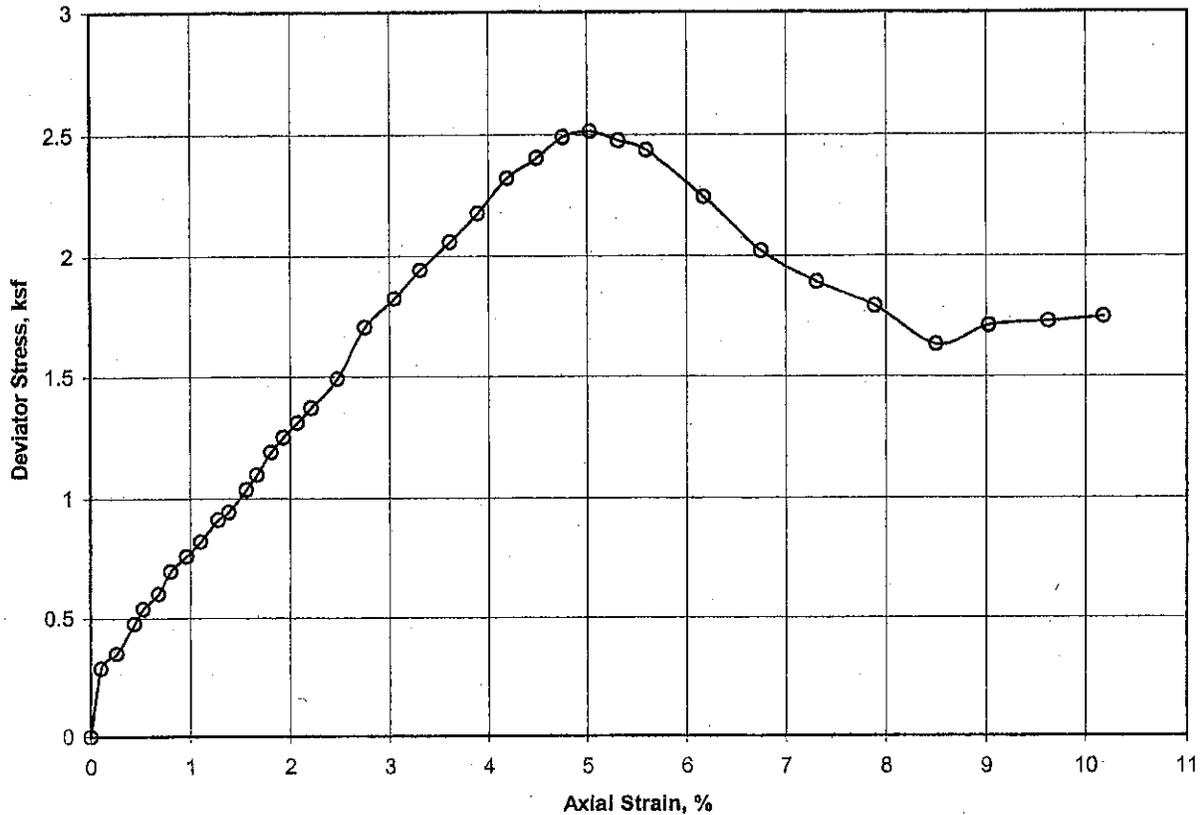
AT FAILURE

STRAIN RATE =	0.60 %/min.
CONFINING PRESSURE =	0.79 ksf
MAX. DEVIATOR STRESS =	9.43 ksf @ 9.2 % STRAIN

PROJECT:
**FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D,
 SCHOFIELD BARRACKS, OAHU, HAWAII**

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST	
GEOLABS, INC. <i>Geotechnical Engineering</i>	
DATE Mar 03	W.O. 3826-20(A)

**UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE
SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850**



LOCATION: B10
 DEPTH: 7 - 7.5 feet
 DESCRIPTION: Brown **SILTY CLAY (CH)**

DRY DENSITY: 80.2 pcf SAMPLE DIAMETER: 2.398 inches
 MOISTURE CONTENT: 33.9 % SAMPLE HEIGHT: 5.702 inches

AT FAILURE

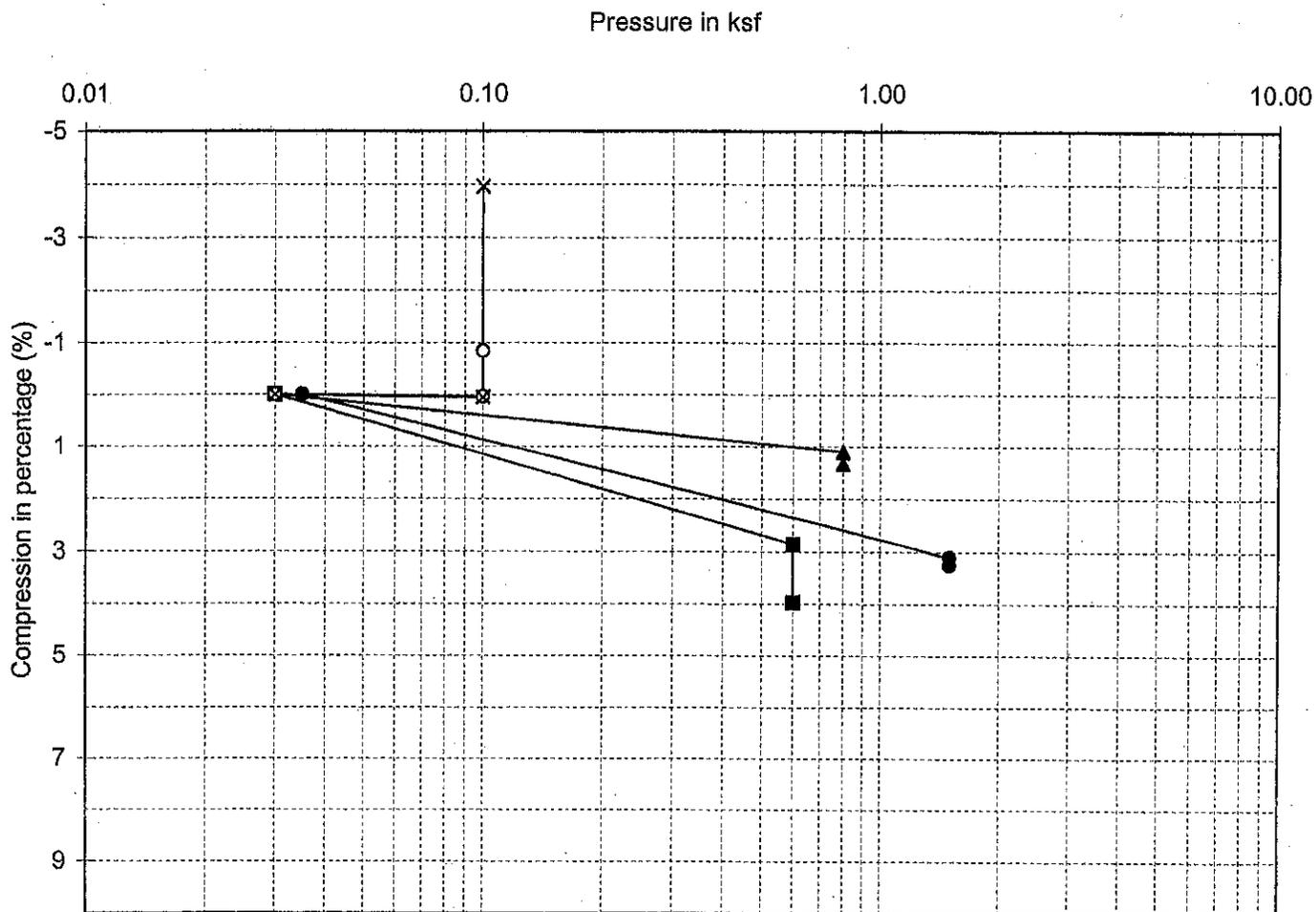
STRAIN RATE = 0.56 %/min.
 CONFINING PRESSURE = 0.72 ksf
 MAX. DEVIATOR STRESS = 2.51 ksf @ 5.0 % STRAIN

PROJECT:
 FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D,
 SCHOFIELD BARRACKS, OAHU, HAWAII

UNCONSOLIDATED UNDRAINED
 TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
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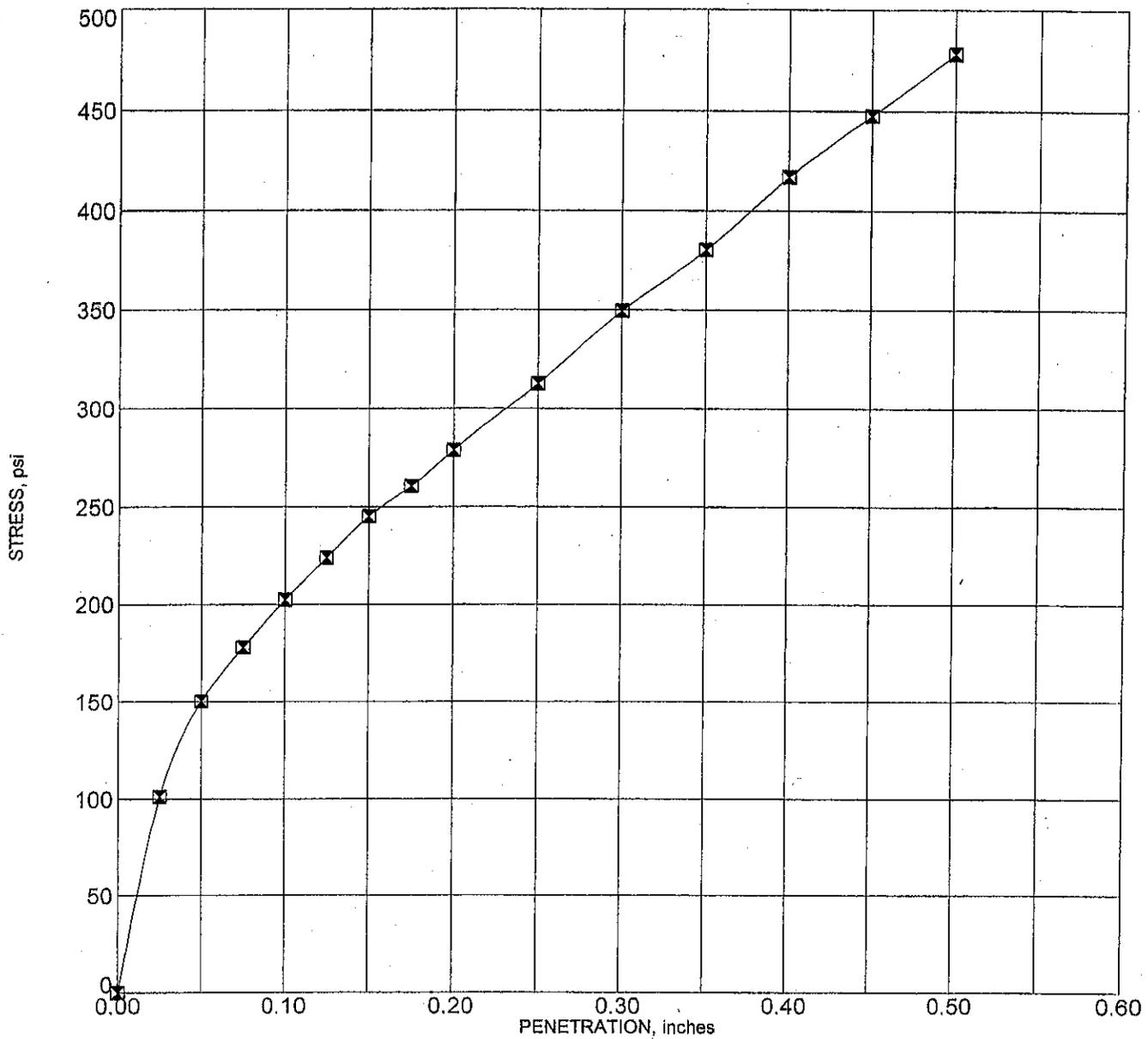
DATE	W.O.
Mar 03	3826-20(A)



Symbol	Location	Depth (feet)	Description	Normal Stress (ksf)	Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Comp. (%)
●	B2	7.5-8.0	Brown SILTY CLAY	1.50	89	29.7	35.2	3.25
▲	B6	4-4.5	Brown SILTY CLAY	0.80	95	29.4	31.7	1.33
■	B9	3-3.5	Brown SILTY CLAY	0.60	79	35.1	40.4	3.97
x	BS#1	0.5-3	Brown SILTY CLAY	0.10	87	28	35	-0.84
o	BS#2	0.5-3	Brown SILTY CLAY	0.10	77	30	45	-3.96

PROJECT:
 FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D
 SCHOFIELD BARRACKS, OAHU, HAWAII

SWELL TEST ASTM D 4546	
GEOLABS, INC.	
<i>Geotechnical Engineering</i>	
DATE Mar-03	W.O. 3826-20(A)



Corr. CBR @ 0.1"	20.2
Swell (%)	0.04

Sample: BS#1
 Depth: 0.5 - 3.0 feet
 Description: Brown SILTY CLAY

Molding Dry Density (pcf)	98.0	Hammer Wt. (lbs)	10
Molding Moisture (%)	27.7	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

G. CBR 3826-20A.GPJ GEOLABS.GDT 3/24/03

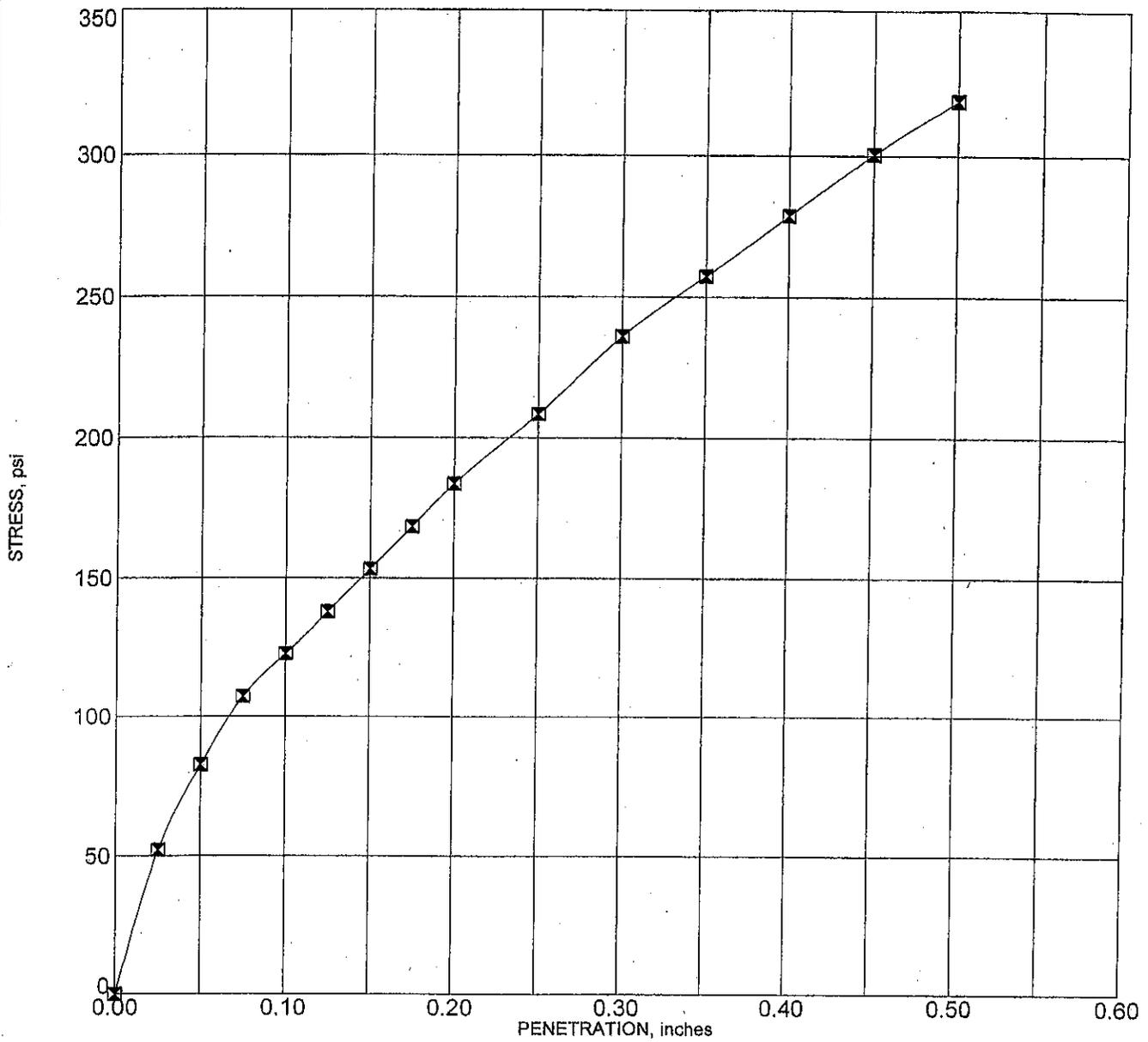


GEOLABS, INC.
 GEOTECHNICAL ENGINEERING
 W.O. 3826-20(A)

CALIFORNIA BEARING RATIO - ASTM D 1883

FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D
 SCHOFIELD BARRACKS, OAHU, HAWAII

Plate
6



Corr. CBR @ 0.1"	12.3
Swell (%)	0.09

Sample: BS#2
 Depth: 0.5 - 3.0 feet
 Description: Brown SILTY CLAY

Molding Dry Density (pcf)	90.4	Hammer Wt. (lbs)	10
Molding Moisture (%)	33.9	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

G. CBR 3826-20A.GPJ GEOLABS.GDT 3/24/03



GEOLABS, INC.
 GEOTECHNICAL ENGINEERING
 W.O. 3826-20(A)

CALIFORNIA BEARING RATIO - ASTM D 1883
 FY03 WHOLE BARRACKS RENEWAL
 PHASE 2C/2D
 SCHOFIELD BARRACKS, OAHU, HAWAII

Plate
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SECTION 02315A

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-- End of Section Table of Contents --

SECTION 02315A

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Testing

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SP-SM, CL, ML, CL-ML, MH.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, and stones larger than 75 mm . The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 30 when tested in accordance with ASTM D 4318.

2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 37.5 mm and no more than 2 percent by weight shall pass the 4.75 mm size sieve.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section 02231 CLEARING AND GRUBBING.

3.2 TOPSOIL

Topsoil shall be stripped to a depth of 150 millimeters below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 1.5 m beyond the building line of each building and structure, excavation for outside grease interceptors, underground fuel tanks, and all work incidental thereof. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed; replaced with satisfactory material; and payment will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced, at no additional cost to the Government, with satisfactory materials to the indicated excavation grade; except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of

construction. French drains, sumps, ditches or trenches will not be permitted within 900 mm of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 1 meter below the working level.

3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.7 BLASTING

Blasting will not be permitted.

3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 150 mm below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section 02300a EARTHWORK.

3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02300a EARTHWORK.

3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus or minus 2 percent of optimum moisture. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 200 mm in loose thickness, or 150 mm when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall

and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under building slabs, steps, and paved areas, top 300 mm	90	95
Under sidewalks, top 150 mm	85	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompression over underground utilities and heating lines shall be by hand tamping.

3.14 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type

operation.

3.14.1 In-Place Densities

In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.

3.14.1.1 In-Place Density of Subgrades

One test per 190 square meters or fraction thereof.

3.14.1.2 In-Place Density of Fills and Backfills

One test per 190 square meters or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 15 meters in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 95 square meters, or one test for each 30 linear meter of long narrow fills 30 meters or more in length. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 300 linear meters of long narrow fills, and a minimum of 2 checks per lift for other fill and backfill areas.

3.14.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

3.14.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material, including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 100 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16 GRADING

Areas within 1.5 m outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 50 mm by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 1.46 kN/m to 2.34 kN/m of roller. Topsoil shall not be placed when the subgrade is excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

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- 3.2 BACKFILLING AND COMPACTION
 - 3.2.1 Trench Backfill
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 - 3.2.1.2 Replacement of Unstable Material
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-- End of Section Table of Contents --

SECTION 02316A

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIAL
(AASHTO)

AASHTO T 180 (1993) Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-inch (456mm) Drop

ANSI/TIA/EIA-758 Customer-Owned Outside Plant
Telecommunications Cabling Standard

ANSI/TIA/EIA-758-1 Addendum No. 1 to TIA/EIA-758
Customer-Owned Outside Plant
Telecommunications Cabling Standard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556 (1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))

ASTM D 2487 (1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests Testing of Backfill Materials

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SP-SM, CL, ML, CL-ML.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, and stones larger than 75 mm . The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic meter or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic meter in volume, except that pavements shall not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 75 millimeters in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum allowable aggregate size shall be 75 millimeters, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill in areas subject to vehicular traffic shall consist of S4C material. Initial backfill material in non-paved areas shall consist of S4C or select granular materials

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm (6 inches) wide with minimum thickness of 0.102 mm (0.004 inch). Tape shall have a minimum strength of 12.1 MPa (1750 psi) lengthwise and 10.3 MPa (1500 psi) crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 meter deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water & Fire Sprinkler Piping Systems
Green:	Chilled Water/Hot Water Distribution Systems

2.3 Detection Wire For Non-Metallic Piping

Detection wire shall be insulated single strand, solid copper with a

minimum diameter of 12 AWG.

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm. Excavated material not required or not satisfactory for backfill shall be removed from the site and disposed of outside the limits of Government-controlled property at Contractor's responsibility. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government. Prior to beginning excavation work, the Contractor shall obtain an excavation permit from DPW. Contractor shall complete the DPW form "Excavation Clearance Requirements" (attached) and submit the completed form to the Contracting Officer and DPW in order to obtain the Excavation Permit. The Contractor shall carry the permit at all times during excavation. Compliance with ANSI/TIA/EIA-758 (Customer-owned outside plant telecommunications cabling standard) and ANSI/TIA/EIA-758-1 Addendum No. 1 to ANSI/TIA/EIA-758 is required.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm (24 inches) plus pipe outside diameter (O.D.) for pipes of less than 600 mm (24 inches) inside diameter and shall not exceed 900 mm (36 inches) plus pipe outside diameter for sizes larger than 600 mm (24 inches) inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe.

Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 25 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 150 millimeters below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.2 Stockpiles

Stockpiles of satisfactory shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional

cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

For trench excavations beneath existing and new roads, streets and parking areas (i.e. all paved areas), final backfill material shall be compacted S4C material or select granular material. For areas not subject to vehicular traffic, final backfill shall be S4C material, select granular material or satisfactory material. Backfill material shall be placed in layers not exceeding 150 mm (6 inches) loose thickness for compaction by hand operated machine compactors, and 200mm (8 inches) loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent of maximum density under roads and paved areas and 90 percent of maximum density in areas not subject to vehicular traffic.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 0.6 meters (2 feet) above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.2.1.3 Bedding and Initial Backfill

Bedding shall be S4C material, thickness as shown. Bedding is required whenever plastic piping is used and optional for all other types of pipe. Bedding material shall be placed and compacted with approved tampers from 100mm (4 inches) below bottom of pipe to the center (spring line) of the pipe. Bedding shall be compacted to min 95% of max density. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

Initial backfill material shall be from the bottom of the pipe (if bedding is not required) or from the top of the bedding to at least 300mm (1 ft) above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe.

<u>Sieve Opening</u>	<u>Percent Passing (%)</u>
12.5 mm	100
9.5 mm	85-100
4.75 mm	10-30
2.36 mm	0-10
1.00 mm	0-5

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways: Backfill shall be placed up to the elevation at which the requirements in Section 02300a EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 14 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 450 mm of cover. The Contractor shall excavate and backfill around gas pipelines in the presence of a representative of The Gas Company.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 1m (3 ft) in areas subject to vehicular traffic and 0.76m (2.5 ft) in all other areas. Cover is defined as the distance from the indicated finished grade or existing ground surface (whichever is lower) to the top of the pipe.

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 6.3 mm in any dimension.

3.3.4 Electrical Distribution System

Conduit or duct line shall have a minimum cover of 600 mm from the finished grade, unless otherwise indicated.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 450 millimeters below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.4.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 30 meters of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic meters of material used. Field in-place density shall be determined in accordance with ASTM D 1556 and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density

tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 0.6 meters above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm (36 inches) shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

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SECTION 02510A

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM C 76M	(1999a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM D 1599	(1999) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of

Thermoplastic Pressure Piping

ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM D 4161	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe Joints Using Elastomeric Seals
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVC0, Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
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AWWA B301 (1992) Liquid Chlorine

AWWA C104 (1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110 (1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA C111 (1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C153 (1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service

AWWA C500 (1993; C500a) Metal-Sealed Gate Valves for Water Supply Service

AWWA C503 (1997) Wet-Barrel Fire Hydrants

AWWA C504 (1994) Rubber-Seated Butterfly Valves

AWWA C509 (1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service

AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606 (1997) Grooved and Shouldered Joints

AWWA C651 (1992) Disinfecting Water Mains

AWWA C701 (1988) Cold-Water Meters - Turbine Type, for Customer Service

AWWA C707 (1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters

AWWA C800 (1989) Underground Service Line Valves and Fittings

AWWA C900 (1997; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

AWWA C901 (1996) Polyethylene (PE) Pressure Pipe and

Tubing, 1/2 In. Through 3 In., for Water Service

- AWWA C905 (1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
- AWWA C909 (1998) Molecularly Oriented Polyvinyl Chloride (PVC) Pressure Pipe, 4 IN through 12 IN (100 mm through 300 mm), for Water Distribution
- AWWA C950 (1995) Fiberglass Pressure Pipe
- AWWA M23 (1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

- ACPPA Work Practices (1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

- DIPRA-Restraint Design (1997) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

- FCCCHR-CCC (1993) Manual of Cross-Connection Control

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 24 (1995) Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 49 (1994) Hazardous Chemicals Data
- NFPA 325-1 (1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
- NFPA 704 (1996) Identification of the Fire Hazards of Materials for Emergency Response

NSF INTERNATIONAL (NSF)

- NSF 14 (1998) Plastics Piping Components and

Related Materials

NSF 61 (1999) Drinking Water System Components - Health Effects (Sections 1-9)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21 (1991) White or Colored Silicone Alkyd Paint

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 1.5 m outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 80 mm (3 inches) in diameter shall be polyvinyl chloride (PVC) plastic, Oriented PVC plastic polyethylene, or copper tubing, unless otherwise shown or specified. Piping for water service lines 80 mm (3 inches) and larger shall be ductile iron, polyvinyl chloride (PVC) plastic, filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 80 mm (3 inches) or larger shall be ductile iron, polyvinyl chloride (PVC) through 900 mm (36 inch) nominal diameter plastic, Oriented PVC plastic filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, unless otherwise shown or specified.

1.2.3 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 1.5 m line.

1.2.4 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.5 Plastic Piping System

Plastic piping system components (PVC, polyethylene, thermosetting resin

and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.6 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 MANUFACTURER'S REPRESENTATIVE

The Contractor shall have a manufacturer's field representative present at the jobsite during the installation and testing of PE, RTRP, and/or RPMP pipe to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the PE, RTRP, and/or RPMP pipe in a satisfactory manner, certification shall be written to note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other condition which could have an adverse effect on the satisfactory completion and operation of the piping system.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation.

The manufacturer's recommendations for each material or procedure to be utilized.

Waste Water Disposal Method.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports

Bacteriological Disinfection.

Test results from commercial laboratory verifying disinfection.

SD-07 Certificates

Manufacturer's Representative.

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of PE, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers, prior to commencing installation.

Installation.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

Meters.

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

1.5 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.5.1 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.5.2 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PE Plastic Pipe

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.1.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 100 mm (4 inch) Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa (150 psi) working pressure, 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 1.03 MPa (150 psi) working pressure, 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure MPa	Minimum Hydrostatic Pressure MPa
26	0.689	0.917

SDR	Maximum Working Pressure MPa	Minimum Hydrostatic Pressure MPa
21	0.827	1.103
17	1.034	1.379
13.5	1.379	1.834

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa (150 psi) working pressure and 1.38 MPa (200 psi) hydrostatic test pressure.

- b. Pipe 100 through 300 mm Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.
- c. Pipe 350 through 900 mm Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.1.3 Oriented Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454-B. Pipe shall conform to AWWA C909, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

2.1.2 Reinforced Plastic Mortar Pressure (RPMP) Pipe

RPMP shall be produced by centrifugal casting and shall have an OD 304 to 1219 mm equal to ductile-iron, with a 1034 kPa pressure rating and with a minimum pipe stiffness of 248 kPa . RPMP shall be in accordance with AWWA C950.

2.1.3 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

2.1.3.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe.

The pipe shall be suitable for a normal working pressure of 1.03 MPa (150 psi) at 23 degrees C. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.3.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.4 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 1.03 MPa (150 psi), unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be coated with an approved coal-tar coating compound. Coating shall be bituminous solvent, coal tar base applied at approximately 20 mils dry film thickness.

2.1.5 Copper Tubing

Copper tubing shall conform to ASTM B 88M , Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

- a. For pipe less than 100 mm (4 inch) diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.
- b. For pipe 100 mm (4 inch) diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 1.03 MPa (150 psi) pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.2 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 150 mm (6 inches) shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

2.2.3 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 1.03 MPa (150 psi) pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606.

Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

2.2.4 Steel Pipe System

2.2.4.1 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.5 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PE Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation, and as approved by the Contracting Officer.

2.3.1.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.1.3 PVC Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

2.3.2 RPMP Pipe

Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161.

2.3.3 RTRP Pipe

2.3.3.1 RTRP-I, Grade 1 and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

2.3.3.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.3.4 Ductile-Iron Pipe Jointing

- a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.
- b. Push-on joints shall conform to AWWA C111.
- c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA C111.

2.3.5 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

- a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.
- b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.3.6 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 1.03 MPa (150 psi) or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name,

initials, or trademark shall be cast on the body of each valve. Valves 50 mm (2 inches) and larger shall be outside lever and spring type.

- a. Valves 50 mm (2 inches) and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.
- b. Valves larger than 50 mm (2 inches) shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 1.03 MPa (150 psi). Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

- a. Valves smaller than 80 mm (3 inches) shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.
- b. Valves 80 mm (3 inches) and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.
- c. Resilient-Seated Gate Valves: For valves 80 to 300 mm (3 to 12 inches) in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal.

Mechanical-end valves 80 through 250 mm in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.4.4 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and

Color shall be Norwood Brown. Appropriate quick-coupler for the 115mm (4-1/2") outlet shall be furnished.

2.8 MISCELLANEOUS ITEMS

2.8.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.8.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.8.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88M , Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.8.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 1.375 MPa (200 psi).

2.8.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 1.03 MPa, 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 67.8 Newton meters (50 foot-pound).

2.8.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw

or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers. Cast-iron service boxes and covers shall be coated with an approved coal-tar coating compound. Coating shall be bituminous solvent, coal tar base applied at approximately 20 mils dry film thickness.

2.8.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.8.8 Meters

Meters shall be vertical turbine type with integral strainer as specified below and shall be supplied by one manufacturer.

2.8.8.1 Horizontal Turbine Type

Horizontal Turbine type meters shall conform to AWWA C701 (Class II). The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type & shall be permanently sealed and shall read in U.S. gallons. Digital indicator-totalizer shall be sealed and magnetically coupled with the driving mechanism. A leak detector hand shall be provided to indicate very low flow (due to leakage). Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be an encoder-type remote register designed in accordance with AWWA C707. Remote mounting adapter kit with up to 15.24m (50') of cable shall be used to connect the water meter to the remote sensor. Remote sensor shall be attached to the building serviced by the meter. See Utility Plan for location of water meter. Locate remote sensor on building being served by the meter. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.8.9 Meter Boxes

Meter boxes shall be of cast iron or concrete. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids shall not be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

As specified in Section 02531 SANITARY SEWERS, PARAGRAPH 3.1.1.1.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 300 mm shall be maintained between pipes.

3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit if required in paragraph 3.1.2.6 Structures. When sleeves are required, the pipe sleeve shall be reinforced concrete pipe for storm drains in accordance with ASTM C 76M, Class V as specified in Section 02630a STORM-DRAINAGE SYSTEM. A minimum clearance of at least 100mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve.

3.1.2.6 Structures

Where water pipe is required to be installed within 1 m of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.3.2 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.3 Allowable for RPMP Pipe

For pipe with bell and spigot rubber gasket joints, maximum allowable deflections from a straight line or grade shall be 4 degrees determined by the diameter, unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown and location suitably stained or marked (as approved by Contracting Officer).

3.1.4.1 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPA

Work Practices.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.4 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 PE Pipe Requirements

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

3.1.5.2 PVC Plastic Pipe Requirements

- a. Pipe less than 100 mm (4 inch) diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.
- b. Pipe 100 through 300 mm diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm (4 inch) diameter with configuration using elastomeric ring gasket.
- c. Pipe 350 through 900 mm diameter: Joints shall be elastomeric gasket push-on joints made in accordance with AWWA M23.

3.1.5.3 RTRP I, RTRP II and RPMP Pipe

- a. RTRP I: Assembly of the pipe shall be done in conformance with

the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved and additional joints shall not be made until the previously laid joints are completely cured.

Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 10.3 MPa (1,500 psi) or greater when carried out in accordance with ASTM D 1599. At any ambient temperature, field bonded epoxy-cemented joints shall be cured with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating, or until the joint has cooled to ambient temperature.

- b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.
- c. RPMP: Bell and spigot gasket-sealing coupling shall be used to connect pipes. The spigot shall be lubricated prior to push-together assembly.
- d. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 3 mm (1/8 inch) thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 135 Newton meters. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

3.1.5.4 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.5 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.6 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 3 mm thickness of coal tar over all fitting surfaces.

3.1.5.7 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 1.5 m outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 50 mm (2 inches) and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply. Fifty (50) mm and smaller connections to existing PVC pipe shall be made with a double strap service clamp of the size indicated in Table 1.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size mm	Corporation Stops, mm For Ductile-Iron Pipe	Outlets w/Service Clamps, mm Single & Double Strap
80	--	25
100	25	25
150	32	40
200	40	50
250	40	50
300 & larger	50	50

NOTE:

- a. Service lines 40 mm (1-1/2 inches) and smaller shall have a service stop.
- b. Service lines 50 mm (2 inches) in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 50 mm (2 inches) shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 80 mm (3 inches) and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.7.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 150 mm (6 inch) branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 450 mm above the finished surrounding grade, and the operating nut not more than 1.2 m above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The

hydrant shall be set upon a slab of concrete not less than 100 mm thick and 400 mm square.

3.1.7.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.7.3 Location of Valves

After delivery, valves, including those in hydrants shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 1.2 m on all sides of the box, or the undisturbed trench face if less than 1.2 m.

3.1.7.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 100 mm (4 inches) in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves 150 mm (6 inches) and larger shall be provided with thrust blocking to prevent movement, except thrust blocking may be omitted for buried valves on concrete pipelines, unless the valve is at or near the end of a buried concrete pipeline. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.9.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly

against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps shall be used to anchor vertical down bends into gravity thrust blocks. Steel rods and clamps shall be protected by galvanizing or by coating with an approved coat-tar compound, approximately 20 mils dry film thickness. Coating shall be bituminous solvent, coal tar base applied at approximately 20 mils dry film thickness.

3.1.9.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa (200 psi). Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.38 MPa (200 psi) pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 34.5 kPa (5 psi) of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIALDISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. From several points in the unit, the Contractor shall take samples of water in proper sterilized containers for bacterial examination. The unit will not be accepted until satisfactory bacteriological results have been obtained. Chlorinated disinfection water shall not be discharged into any drainage system unless it meets the requirements of the Hawaii Administrative Rules Chapter 11-54, Water Quality Standards. The chlorinated disinfection water may be used for watering grassy areas if the chlorine concentration is reduced to that of drinking water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

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SECTION 02531

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

- ACPA 01-102 (1988) Concrete Pipe Handbook
ACPA 01-103 (1995) Concrete Pipe Installation Manual

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

- AREMA 1-5 (2001) Pipelines

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 276 (2003) Standard Specification for
Stainless Steel Bars and Shapes
ASTM A 74 (1998) Cast Iron Soil Pipe and Fittings
ASTM A 746 (1999) Ductile Iron Gravity Sewer Pipe
ASTM C 12 (2002) Installing Vitrified Clay Pipe Lines
ASTM C 14M (1999) Concrete Sewer, Storm Drain, and
Culvert Pipe (Metric)
ASTM C 150 (2002) Portland Cement
ASTM C 260 (2001) Air-Entraining Admixtures for
Concrete
ASTM C 270 (2001a) Mortar for Unit Masonry
ASTM C 33 (2001a) Concrete Aggregates
ASTM C 425 (2002) Compression Joints for Vitrified
Clay Pipe and Fittings
ASTM C 443M (2001) Joints for Circular Concrete Sewer
and Culvert Pipe, Using Rubber Gaskets

	(Metric)
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(2002) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76M	(2000) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 828	(2001) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923M	(1998) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 924M	(1989; R 1998) Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric)
ASTM C 94	(1994) Ready-Mixed Concrete **
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 969M	(2000) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 972	(2000) Compression-Recovery of Tape Sealant
ASTM C 990	(2001a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers
ASTM C 990M	(2001a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(2001) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(1996a) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2001) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2001) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(2001) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(2001) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3034	(2000) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(2002) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(2002) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3753	(1999)Glass-Fiber-Reinforced Manholes
ASTM D 3840	(2001) "Fiberglass"

	(Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 4161	(2001) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D 624	(2000) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(2001) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2001a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153	(2000) Ductile-Iron Compact Fittings for

Water Service

- AWWA C600 (1999) Installation of Ductile-Iron Water Mains and Their Appurtenances
- AWWA C900 (1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
- AWWA M23 (1980) Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

- ASME B1.20.1 (1983; R 2001) Pipe Threads, General Purpose, Inch

CAST IRON SOIL PIPE INSTITUTE (CISPI)

- CISPI 301 (2000) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- CISPI 310 (1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- FS A-A-60005 (1998) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole ++

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

- UBPPA UNI-B-3 (1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
- UBPPA UNI-B-6 (1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.3 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast concrete manhole

Metal items

Frames, covers, and gratings

SD-03 Product Data

Pipeline materials including joints, fittings, and couplings

Submit manufacturer's standard drawings or catalog cuts.

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03300, Cast-In-Place Concrete.

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A 74, service, with ASTM C 564 compression-type rubber gaskets. When installed underground pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA C105.

2.1.1.2 Cast-Iron Hubless Soil Pipe and Fittings

CISPI 301 with CISPI 310 coupling joints.

2.1.2 Clay Piping

2.1.2.1 Clay Pipe and Fittings

ASTM C 700, extra strength bell-and-spigot piping only.

2.1.2.2 Clay Piping Jointing Materials

ASTM C 425.

2.1.3 Concrete Gravity Sewer Piping

2.1.3.1 Concrete Gravity Pipe and Fittings

Concrete pipe 24 inches or less in diameter, shall be nonreinforced and conform to ASTM C 14M, Class 1, unless otherwise specified.

2.1.3.2 Jointing Materials for Concrete Gravity Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443M. Gaskets shall be suitable for use with sewage.

2.1.4 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.4.1 Ductile Iron Gravity Pipe and Fittings

Ductile iron pipe shall conform to ASTM A 746, Thickness Class 52. Fittings shall conform to AWWA C110 or AWWA C153. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved by the Contracting Officer, for push-on joint. Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104, standard thickness.

2.1.4.2 Ductile Iron Gravity Joints and Jointing Materials

Pipe and fittings shall have push-on joints or mechanical joints, except as otherwise specified in this paragraph. Mechanical joints only shall be used where indicated. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111. Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.

2.1.5 ABS Composite Plastic Piping

2.1.5.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.5.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.6 ABS Solid-Wall Plastic Piping

2.1.6.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.6.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.7 PVC Plastic Gravity Sewer Piping

2.1.7.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints. ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm through 1200 mm diameters.

2.1.7.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.8 PVC Plastic Pressure Pipe and Associated Fittings

2.1.8.1 PVC Plastic Pressure Pipe and Fittings

- a. Pipe and Fittings Less Than 100 mm Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785, Schedule 80, with joints meeting requirements of 1.03 Mpa working pressure, 1.38 Mpa hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 Mpa working pressure and 1.38 Mpa hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

- b. Pipe and Fittings 100 mm Diameter to 300 mm: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110 or AWWA C153 and shall have cement-mortar lining conforming to AWWA C104, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.8.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 100 mm to 300 mm diameter, shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type

joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111, respectively, for push-on joints and mechanical-joints.

2.1.9 High Density Polyethylene Pipe

ASTM F 714, size 100 mm (4 inch)) through 1200 mm (48 inch). The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to $1170/D$ for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: ASTM F 894. Joints for high density polyethylene pipe: Rubber gasket joints shall conform to ASTM C 443M .

2.1.10 Reinforced Plastic Mortar Pipe (RPMP)

Reinforced plastic mortar pipe shall be produced by centrifugal casting and shall have an outside diameter equal to ductile iron pipe dimensions from 450 mm to 1200 mm . The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 248 kPa . RPMP shall be in accordance with ASTM D 3262. Fittings for RPMP: ASTM D 3840. Joints for RPMP: Bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161 and ASTM F 477.

2.1.11 Reinforced Thermosetting Resin Pipe (RTRP)

RTRP pipe: ASTM D 3262. Fittings for RTRP: ASTM D 3262. Joints for RTRP: Bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.1.11.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 1.03 MPa (150 psi) at 22.8 degrees C (73 degrees F). The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.11.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.12 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping shall conform to the specifications for pipelines conveying nonflammable substances in AREMA 1-5, except as otherwise specified in this

paragraph. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.2 Portland Cement

Portland cement shall conform to ASTM C 150, Type V for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalies shall be used.

2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa (4000 psi) at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from moisture loss for 7 days.
Text

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes and Glass-Fiber-Reinforced Polyester Manholes.

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478M; base and first riser shall be monolithic.
Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443M. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923M or ASTM C 990M.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene

Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, kPa	ASTM D 412	12,684	15,132	-
Elongation percent	ASTM D 412	553	295	350
Tear Resistance, N/mm	ASTM D 624 (Die B)	49	28	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as follows:

- a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

- b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg (400 pounds). Cast iron and ductile iron frames and covers shall be coated with an approved coal tar compound. Coating thickness shall be approximately 20 mils dry film thickness. The word "Sewer" shall be cast into covers so that it is plainly visible.

2.3.4.2 Stainless Steel Ladders

A stainless steel ladder shall be provided where the depth of a manhole exceeds 1 m (3 feet). The ladder shall not be less than 406 mm (16 inches) in width, with 19 mm (3/4 inch) diameter rungs spaced 305 mm (12 inches) apart. The two stringers shall be a minimum 10 mm (3/8 inch) thick and 51 mm (2 inch) wide. Ladders and inserts shall be fabricated of AISI Type 304 stainless steel in conformance with ASTM A 276.

2.4 MANHOLE INSERTS

Manhole Inserts: Manholes in paved areas (and unpaved areas subject to ponding) shall have a manhole insert fully seated around the manhole frame rim to prevent water from infiltrating between the cover and the manhole frame rim. (Manhole frame shall be cleaned of all dirt and debris prior to placing the manhole insert on the rim.)

Manhole Inserts (similar to "No Flow Inflow Dish" or approved equal) shall be made of high density polyethylene copolymer material that meets ASTM specification designation D1248, Class A, Category 5, Type 111 (the insert shall have a minimum impact brittleness temperature of -180 deg F). The thickness shall be uniform 3mm or greater. The insert shall be manufactured to the dimensions as shown on the contract drawings to allow easy installation within the manhole frame. A lift strap shall be attached to the rising edge of the bowl of the insert. The lift strap shall be made of 1" width woven polypropylene web and shall be seared on all cut ends to prevent unraveling. The lift strap shall be attached to the insert by means of a stainless steel rivet. Location of the lift strap shall be such as to provide easy visual location. Ventilation of the Insert shall be via a vent hole located on the side wall of the dish 19mm below the lip. The hole thus placed allows a maximum release of 38 liters per 24 hours and is not affected by debris that might collect at the bottom of the dish.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 1.5 m from the building, unless otherwise indicated. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 3 m to a water main or service line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 3 m on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance with no joint located within 900 mm horizontally of the crossing. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in

the sewer line will be closer than 0.9 m, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 3 m horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 3 m, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 450 mm below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary piping crossing water lines to provide a separation of at least 450 mm between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling, or sewer pipe fully encased in concrete for a distance of 3 m on each side of crossing.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 450 mm between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 6.1 m, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or

come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Sleeves

Sewer pipe shall be encased in a sleeve of rigid conduit if required in paragraph 3.1.2.3 Structural Foundations. When sleeves are required, the pipe sleeve shall be reinforced concrete pipe for storm drains in accordance with ASTM C 76M, Class V as specified in Section 02630a STORM-DRAINAGE SYSTEM. A minimum clearance of at least 50mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the sewer pipe through the sleeve.

3.1.1.3 Earthwork

Perform earthwork operations in accordance with Section 02300a EARTHWORK, 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.1.1.4 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 7.50 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.5 Joints

Joint installation shall comply with the manufacturer's instructions. "Biobarrier" or other approved equal root barrier shall be wrapped around all joints of new sewer pipes and appurtenances within the spread (branches and leaves) of existing trees and 6m (20 ft) from center of newly planted trees. The root deterrent material shall extend a minimum of 230mm (9") on either side of the joint. Overlap of material shall be 100mm (4") minimum. Method of fastening material to the pipe shall be with plastic ties or as recommended by the manufacturer and subject to the approval of the Contracting Officer

3.1.1.6 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to

existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.1.7 Abandoned Manholes and Sewer Lines

Unless otherwise indicated, all existing sewer manholes indicated to be demolished on the demolition plan shall be demolished and completely removed from the site. Sewer manholes indicated to be abandoned shall have all connecting sewer lines plugged with concrete at each end. The concrete plug shall extend from the manhole a minimum 2 feet into the abandoned line.

Abandoned sewer manholes should have the manhole bottoms cracked to permit subsurface water drainage through the bottom. The manhole should be backfilled with (a) compacted granular material such base course or S4C or (b) lean concrete. The manhole cover should be completely removed along with the manhole cone or the upper 3 feet for cast-in-place manholes.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of Clay Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM C 12 for pipe laying. Make joints with a compression joint material specified for clay pipe joints and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.1.2.3 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 25 mm of closure, remove the pipe and remake the joint.

3.1.2.4 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111.

3.1.2.5 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.6 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.7 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.8 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 100 mm Diameter:

- (1) Threaded joints shall be made by wrapping the male threads

with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

(2) Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

(3) Solvent-weld joints shall comply with the manufacturer's instructions.

- b. Pipe 100 mm Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.
- c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94 having a minimum compressive strength of 13.80 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03300, Cast-In-Place Concrete.

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

- a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.
- b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and

apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Spills

Any sewage spill occurring as a result of Contractor's operations shall be stopped immediately. DPW Environmental Division shall be notified immediately (656-2878 x1049). Contaminated areas shall be cleaned and disinfected. Contractor shall accomplish any required shoreline monitoring of waters as required by the State Dept of Health and/or Environmental Protection Agency. The Contractor shall develop an after-action plan addressing problems and corrective actions that will be implemented to prevent spills from occurring again.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe. The Contractor shall submit CCTV tapes of the newly installed sewer pipes after trench backfill has been placed. In addition, the Contractor shall submit CCTV of the existing sewers. The first 400 lineal feet upstream and 400 lineal feet downstream from the point of connection to new sewer shall be CCTV'd.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

- a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969M. Make calculations in accordance with the Appendix to ASTM C 969M.
- b. Low-pressure air tests: Perform tests as follows:
 - (1) Clay pipelines: Test in accordance with ASTM C 828. Allowable pressure drop shall be as given in ASTM C 828. Make calculations in accordance with the Appendix to ASTM C 828.
 - (2) Concrete pipelines: Test in accordance with ASTM C 924M. Allowable pressure drop shall be as given in ASTM C 924M. Make calculations in accordance with the Appendix to ASTM C 924M.
 - (3) Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924M. Allowable pressure drop shall be as given in ASTM C 924M. Make calculations in accordance with the Appendix to ASTM C 924M.
 - (4) ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.
 - (5) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

- a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back

sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

- (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
 - (2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4 degrees C, and shall have a surface Brinell hardness of not less than 150.
 - (3) Center bored and through-bolted with a 6 mm minimum diameter steel shaft having a yield strength of not less than 483 MPa, with eyes or loops at each end for attaching pulling cables.
 - (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
- b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.
- c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.
- d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

-- End of Section --

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SECTION 02555A

PREFABRICATED UNDERGROUND HEATING/COOLING DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI H35.1 (1997) Alloy and Temper Designation Systems for Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M (2001) Carbon Steel Forgings for Piping Applications

ASTM A 106 (1999e1) Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 167 (1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 234/A 234M (2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

ASTM A 53/A 53M (2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASME B16.34 (1997) Valves - Flanged, Threaded, and Welding End

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASTM B 88M (1999) Seamless Copper Water Tube (Metric)

ASTM C 518 (1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 3350	(2000) Polyethylene Plastics Pipe and Fittings Materials

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
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1.2 SYSTEM DESCRIPTION

The system consists of a buried prefabricated chilled water and low temperature hot water distribution system including service connections to a point 150 mm inside of the building. The contract drawings show the specific arrangement of piping, sizes and grades of pipe, and other details. The system is designed for an operating pressure of 660 kPa and an operating temperature of 60 degrees C for hot water and 7 degrees C for chilled water.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Distribution System

Detail drawings consisting of fabrication and assembly drawings, for all parts of the work in sufficient detail to check conformity with the requirements of the contract documents, prior to installation. Detail drawings shall also contain complete piping, wiring and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, method of compensation for pipe expansion and contraction, anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances required for maintenance and operation. The drawings shall clearly identify any proposed deviations from the requirements of the contract documents.

SD-03 Product Data

Distribution System

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

SD-07 Certificates

Distribution System

The manufacturer's or system fabricator's written certification stating that the distribution system furnished meets all the requirements of this specification.

Welding

Prior to welding operations, a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-10 Operation and Maintenance Data

Distribution System

Six copies of operation and 6 copies of maintenance manuals for the equipment furnished, 1 complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for equipment startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features.

Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the equipment system as installed. Manuals shall be approved prior to the field performance testing.

1.4 DELIVERY AND STORAGE

After delivery to the jobsite, all materials and equipment shall be protected from anything which could cause damage to the material or equipment. Pipe shall be sealed at each end to keep the interior clean and free of dirt and debris. Fittings shall be kept together and their interior surfaces shall remain clean. Insulation shall be kept dry and clean.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

System components shall be standard products of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The system shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 PIPING AND CASING MATERIALS

2.2.1 General

Metallic pressure pipe, fittings, and piping accessories shall conform to the requirements of ASME B31.1 and shall be types suitable for the temperature and pressure of the water. Carrier pipe for chilled water supply, chilled water return, heat pump water supply, and heat pump water return shall be steel pipe or copper tubing.

2.2.2 Carrier Piping

2.2.2.1 Steel Pipe

Piping shall conform to ASTM A 53/A 53M, Grade B, standard weight, black or to ASTM A 106, Grade B, standard weight.

2.2.2.2 Copper Tubing

Copper tubing shall conform to ASTM B 88M , Type K.

2.2.3 Casings

2.2.3.1 Polyvinyl Chloride (PVC) Casing

PVC casings shall conform to ASTM D 1784, Class 12454-B with a minimum thickness equal to the greater of 1/100 the diameter of the casing or 1.50 mm (60 mils).

2.2.3.2 Polyethylene (PE) Casing

Polyethylene casings shall conform to ASTM D 3350, Type III, Class C, Category 3 or 4, Grade P 34 with thickness as follows:

Casing Diameter (in mm)	Minimum Thickness (in mm)
250 and smaller	3
250 to 450	4

2.2.3.3 Reinforced Thermosetting Resin Pipe (RTRP) Casing

RTRP casing shall be of the same material as the pipe, with casing thickness as follows:

Casing Diameter (in mm)	Minimum Thickness (in mm)
200 and smaller	1.2
250	2
300	2.7
350	2.9

2.3 PIPING CONNECTIONS

2.3.1 Steel Pipe

Steel pipe smaller than 20 mm (3/4 inch) may be threaded; otherwise, all steel pipe shall be welded. Steel welding fittings shall conform to the requirements of ASTM A 105/A 105M or ASTM A 234/A 234M. Welding fittings shall also conform to ASME B16.9 for butt weld fittings and ASME B16.11 for

socket-weld fittings. Long radius butt welding elbows conforming to ASME B16.9 shall be used whenever space permits. Pipe Threads shall conform to ASME B1.20.1. Pipe to be threaded shall be schedule 80.

2.3.2 Copper Pipe

Copper pipe shall be brazed or connected using an insulated pipe coupling. Wrought copper or cast copper alloy solder joint pressure fittings shall conform to MSS SP-73. Insulated pipe couplings for copper pipe shall be cast bronze containing an O-ring seal on each end and shall be jacketed and sealed to act as an expansion joint.

2.4 END SEALS

2.4.1 General

Each preinsulated section of piping shall have a complete sealing of the insulation to provide a permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. End seals must be tested and certified in accordance with paragraph Casing and End Seal Testing and Certification.

2.4.2 Types

End seals provided shall be one of the following types:

- a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Sufficient surface bonding area shall be provided between the casing and the carrier pipe.
- b. Using specially designed molded caps made of polyethylene or rubber of standard manufactured thickness. A minimum 40 mm surface bonding area shall be provided between the cap and both the casing and carrier pipe.
- c. Using elastomer-ring end seals designed and dimensioned to fit in the annular space between the casing and the carrier pipe.
- d. Using a waterproof mastic seal vapor barrier over the exposed insulation ends.
- e. Shrink sleeves.

2.4.3 Casing and End Seal Testing and Certification

Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of water into the casing and insulation. The test shall be performed on the type of prefabricated system to be furnished. If more than one type of prefabricated system is to be used, then the tests shall be performed on each type. The test shall consist of hot and cold cycle testing followed by immersion in a water filled chamber with a head

pressure. The hot and cold cycle testing shall consist of 14 days of temperature cycling. A fluid with a temperature of 5 degrees C shall circulate through the carrier pipe alternating every 24-hours with a fluid with a temperature of 95 degrees C circulating through the carrier pipe for a low temperature hot water or dual temperature service or 24 degrees for a chilled water service. While the hot and cold cycle test is being performed, the test sample is either buried or encased in dry bedding sand with a minimum of 300 mm of sand all around the test sample. The carrier pipe size of the test sample shall be 80 mm (3 inches) in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project. Transition time for temperature cycle testing shall not exceed 15 minutes in going from cold to hot and 30 minutes in going from hot to cold. The fluid in the carrier pipe may be water, oil or heat transfer fluid. Following the hot and cold cycling test, the test sample shall be immersed in a water filled chamber. The pressure on the highest point of the test sample shall not be less than 60 kPa subjected over the entire length of the 2.4 m test sample of prefabricated pipe. The water shall contain a dye penetrant, which will be used to check for end seal leakage. The pressure in the chamber must be held for not less than 48 hours. Upon completion of this pressure test, the test sample shall be cut open. With the use of a light that will readily show the presence of the dye that was in the water, the test sample shall be inspected. Evidence of the dye inside the test sample shall indicate that the end seal is not acceptable and cannot be certified.

2.5 INSULATION

2.5.1 Factory Applied Insulation

Prefabricated pipe and fittings shall be insulated in the factory. Foam insulation for prefabricated insulated pipe and fittings shall be polyurethane foam meeting the requirements of ASTM C 591 having a density not less than 32 kg per cubic meter. The polyurethane foam shall completely fill the annular space between the carrier pipe and the casing. Insulation thickness shall be a minimum of 20 mm. The insulation thermal conductivity factor shall not exceed the numerical value of 0.02 W/mK (0.15 Btu-inch/square foot-degree F-hour) at 24 degrees C, when tested in accordance with ASTM C 518. Manufacturer shall certify that the insulated pipe is free of insulation voids.

2.5.2 Field Applied Insulation

Field applied insulation for buried fittings, valves, and field casing closures, if required, and other piping system accessories shall be polyurethane matching the pipe insulation. Thickness shall match adjacent piping insulation thickness. Buried fittings, valves, and accessories shall have field applied polyurethane insulation to match adjacent piping and shall be protected with a covering matching the pipe casing. Shrink sleeves with a minimum thickness of 1.3 mm shall be provided over casing connection joints.

2.5.3 Insulation of Vault Valves and Fittings

Flanges, unions, valves, and fittings inside valve vaults shall be insulated with premolded prefabricated, or field fabricated segments of insulation of the same material and thickness as the prefabricated distribution pipe insulation. Insulation shall be removable and reusable and shall have essentially the same thermal characteristics and thickness as the adjoining piping. Insulation shall be protected by a covering matching the pipe casing.

2.5.4 VALVES

Unless otherwise specified, valves shall comply with the material, fabrication, and operating requirements of ASME B31.1. Valves shall be suitable for the temperature and pressure requirements of the system on which used. Valves 20 mm (3/4 inch) and smaller may be bronze. Valves 150 mm (6 inches) and larger shall have a 25 mm (1 inch) minimum gate or globe bypass valve sized in conformance with MSS SP-45.

2.5.4.1 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 1.03 MPa (150 psig). Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.4.2 Gate and Globe Valves

Steel gate and globe valves shall conform to the requirements of ASME B16.34 and ASME B31.1 for the temperature and pressure requirements of the system. Gate valves 65 mm (2-1/2 inches) inches and smaller shall be rising stem. Gate valves 80 mm (3 inches) and larger shall be outside screw and yoke. Bronze gate and globe valves shall conform to requirements of MSS SP-80, union bonnet type.

2.5.4.3 Ball Valves

Ball valves shall conform to MSS SP-72 for flanged or buttwelded valves or MSS SP-110 for threaded ball valves.

2.5.4.4 Packing

Packing used with valves shall not contain asbestos. Valve stem packing shall be die-formed, ring type specifically designated as suitable for the temperature and pressure of the service and compatible with the fluid in the system. Packing shall be polytetrafluoroethylene with minimum 50 percent graphite filament. Valves 40 mm (1-1/2 inches) and smaller shall have four or five packing rings and valves 50 mm (2 inches) and larger shall have at least six packing rings. Spiral or continuous packing will not be acceptable. A metal insert shall be provided having proper clearance

around the valve stem at the bottom of the stuffing box and acting as a base for the packing material. Packing glands shall be furnished with a liner of noncorrosive material and shall be of one piece construction with provisions for not less than two bolts for packing adjustment.

2.5.5 PRESSURE GAUGES

Gauges shall conform to ASME B40.1, and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Minimum dial size shall be 110 mm (4-1/4 inches). 4-1/4 inches.

2.5.6 DIAL THERMOMETERS

Dial type thermometer shall be 90 mm (3-1/2 inches) 3-1/2 inches in diameter with stainless steel case, remote-type bulb or direct-type bulb as required. The thermometer shall have an accuracy of plus or minus 1 degree C (2 degrees F). Thermometer wells of the separable socket type shall be provided for each thermometer with direct-type bulb. The thermometer shall have a white face with black digits graduated in 1 degree C (2 degrees F) increments.

2.9 CONCRETE VALVE VAULTS AND ACCESSORIES

2.5.7 Valve Vault Construction

Valve vault dimensions shall be as indicated. The valve vault shall be constructed of reinforced concrete as indicated. Valve vault shall be drained as shown. Concrete sections shall not be less than 200 mm (8 inches) thick. The vault top shall be fabricated from stainless steel or hot dipped galvanized steel. The top shall be solid plate cover (6 mm thick checker pattern) conforming to ANSI H35.1. The top of the grate will be at least 150 mm (6 inches) above the surrounding grade, except when installed in concrete walkways, in which case the top of the grate will be flush with the surrounding concrete walkway. All steel components shall be protected from corrosion.

2.5.8 Ladders

Valve vault ladders shall be steel, shall have nonslip surfaces, and shall consist of uprights with steps or rungs. Ladders shall not be less than 406.4 mm (16 inches) in width, with 19.1 mm (3/4 inch) diameter rungs, spaced 304.8 mm (12 inches) apart. The two stringers shall be a minimum 9.5 mm (3/8 inch) thick and 63.5 mm (2-1/2 inches) wide. Ladders shall be adequately anchored to the wall by means of steel inserts spaced not more than 2 m (6 feet) apart vertically, and installed to provide at least 150 mm (6 inches) of space between the wall and rungs. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5.9 Pipe Sleeves

Pipe sleeves of sufficient length to pass through valve vault walls shall be provided. Pipe sleeves shall be zinc-coated steel pipe, conforming to the requirement of ASTM A 53/A 53M, Schedule 40 or standard weight. The pipe sleeves shall be secured in the proper position and location during

construction of the valve vault wall. The space between the sleeve and the pipe casing, and the caulking and sealing materials shall be selected so there shall be NO electrical continuity between the pipe sleeve and the pipe casing when finished.

A modular mechanical type sealing assembly will be used between the valve vault pipe sleeve and the chilled water or hot water pipe casing. The mechanical seal shall consist of interlocking elastomeric links shaped to continuously fill the annular space between the casing and sleeve. The link material shall be a synthetic elastomeric capable of withstanding long term exposure at 205 degrees C (400 degrees F) without deterioration. The links shall be attached to each other with corrosion resistant steel bolts, nuts and pressure plates. The link, bolts, nuts and pressure plates shall be the product of single manufacturer and shall be furnished as the product of single manufacturer and shall be furnished as a package or kit. The links shall be loosely assembled with bolts to form a continuous rubber belt around the casing with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the casing and the sleeve. The pipe sleeve diameter shall be sized so that no more than one half of the seal assembly's expansion capability is used to achieve a water seal.

PART 3 EXECUTION

3.1 INSTALLATION

For all preinsulated, prefabricated systems, the Contractor shall obtain the services of a trained representative of the pipe system manufacturer to instruct the Contractor's work forces in the installation procedures to ensure that the system is installed in accordance with the manufacturer's published instructions and the plans and specifications. The manufacturer's representative shall be a person who regularly performs such duties for the manufacturer. The Contractor shall furnish the Contracting Officer a list of names of personnel trained and certified by the pipe system manufacturer in the installation of this system. Only personnel whose names appear on the list will be allowed to install the system. The list shall not be more than 1 year old.

3.2 PIPING SYSTEMS

3.2.1 Buried Insulated Systems

Buried insulated systems shall consist of carrier pipe, insulation, casing, end seals, fittings and accessories as specified.

3.3 THRUST BLOCKS

Thrust blocks shall be installed at the locations shown or recommended by the pipe system manufacturer. Thrust blocks may not be required on all systems, and the need for thrust blocks shall be as recommended by the system manufacturer. Thrust blocks, if necessary, shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees. Thrust blocks shall be concrete having a

compressive strength of not less than 14 MPa (2000 psi) after 28 days and shall be in accordance with Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

Thrust blocks shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of the thrust blocks not subject to thrust may be poured against forms. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair wherever possible. No pipe joint shall be embedded in concrete unless the assembly has previously been hydrostatically tested. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions. In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck which shall be replaced with ballast of sufficient stability to resist thrusts.

3.4 INSTALLATION OF PIPING SYSTEMS

The piping system furnished shall be installed in accordance with the piping system manufacturer's instructions. Piping shall be installed without springing or forcing other than what has been calculated for cold spring. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints or hangers. Nonmetallic pipe cut in the field shall be machined to fit couplings or joints and shall be coated or treated to match standard factory coated ends. Copper tubing shall not be installed in the same trench with ferrous piping materials. When nonferrous metallic pipe (e.g., copper tubing) crosses any ferrous piping material, a minimum vertical separation of 300 mm shall be maintained between pipes. Connections between different types of pipe and accessories shall be made with transition fittings approved by the manufacturer of the piping system.

3.4.1 Pitching of Horizontal Piping

Horizontal piping shall be pitched at a grade of not less than 40 mm in 1 m toward the drain points unless otherwise indicated.

3.4.2 Open Ends

Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

3.4.3 Cutting Prefabricated Piping Sections

Where prefabricated pipe sections are field cut, new end seals similar to the factory applied end seal shall be provided and installed in accordance with the manufacturer's instructions.

3.4.4 Joints

3.4.4.1 Welded Joints

Welded joints between sections of pipe and between pipe and fittings shall

be provided where specified or indicated.

3.4.4.2 Threaded Joints

Threaded joints shall not be used belowground. Joints shall be made tight with polytetrafluoroethylene tape applied to the male threads only. Not more than 3 threads shall show after the joint is made up.

3.4.4.3 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be the products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.4.4.4 Brazed Joints

Brazed joints for copper pipe and fittings shall conform to CDA Tube Handbook. Brazing alloys melting above 593.3 degrees C (1100 degrees F) shall be utilized.

3.4.4.5 Nonmetallic Pipe Joints

Nonmetallic pipe joints shall be installed in accordance with the written instructions of the manufacturer.

3.4.5 Expansion Loops

If expansion compensation is needed, expansion loops and expansion bends (Z- and L- type) shall be factory fabricated of casing, insulation, and carrier piping identical to that furnished for straight runs. Expansion loops and bends shall be properly designed in accordance with the allowable stress limits indicated in ASME B31.1 for the type of pipe used. Expansion loops and bends shall be shipped to the jobsite in the maximum size sections feasible to minimize the number of field joints. The expansion loops and bends casing and insulation where applicable, shall be suitably sized to accommodate pipe movement. Field joints shall be made in straight runs of the expansion loops and bends, and the number shall be kept to a minimum. For steel pipe, cold springing shall not be allowed when sizing the expansion loops and bends, but piping shall be cold sprung one-half the calculated maximum operational expansion during field assembly. Pipe stress in expansion loops and bends shall conform to the requirements for expansion loops specified in ASME B31.1.

3.4.6 Anchors

Anchor design shall be in accordance with the published data of the

manufacturer and for prefabricated systems shall be factory fabricated by the prefabricated system manufacturer. In all cases, the design shall be such that water penetration, condensation, or vapor transmission will not wet the insulation.

3.4.7 Field Casing Closures

Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material shall be foamed in place polyurethane. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound, continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 150 mm minimum overlap at each end.

3.4.8 Underground Warning Tape

Underground warning tape shall be buried above the piping during the trench backfilling and shall be buried approximately 300 mm deep. Tape shall be polyethylene tape with metallic core. Tape shall be 150 mm wide and be printed with repetitive caution warnings along its length. Tapes shall be yellow in color with black letters. Tape color and lettering shall not be affected by moisture or other substances contained in the backfill material.

3.4.9 Markers for Underground Piping

Markers for underground piping shall be placed as indicated approximately 600 mm to the right of the distribution system and referenced to the flow direction in the supply line. The marker shall be concrete 150 mm square or round section 600 mm long. The top edge of the marker shall have a minimum 10 mm chamfer all around. The letters CHW or LHW shall be impressed or cast on the top of the markers to indicate the type of system that is being identified. Each letter shall be formed with a V-shaped groove and shall have a width of stroke at least 6 mm at the top and depth of 6 mm. The top of the marker shall protrude not more than 25 mm above finished grade.

3.5 EARTHWORK

Earthwork shall be performed in accordance with Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.6 ELECTRICAL WORK

Electrical work shall be performed in accordance with either Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.7 TESTING

Tests shall be conducted before, during, and after installation of the system. All instruments, equipment, facilities, and labor required to

properly conduct the tests shall be provided by the Contractor. Test pressure gauges for a specific test shall have dials indicating not less than 1-1/2 times nor more than 2 times the test pressure. It shall be the Contractor's responsibility to make the pipe system workable at his expense.

3.7.1 Carrier Pipe Cleaning and Testing

Distribution piping shall be tested as required before backfilling and with all joints exposed. The area between joints may be backfilled as necessary to prevent pipe movement.

3.7.1.1 Cleaning Carrier Pipe

Prior to testing, the interior of the carrier pipe shall be cleaned of foreign materials by thorough flushing with clean water. Water shall be circulated at a velocity between 2 and 3 m/s (7 and 10 feet per second) for a minimum of 4 hours. If required, temporary and/or supplementary pumps shall be provided to ensure that required velocity is achieved. System strainers shall be cleaned after the flushing operation is complete. Temporary strainers shall be installed as required. After flushing, the water shall remain in the piping system for testing of the system. All air shall be removed from the system prior to starting the tests.

3.7.1.2 Hydrostatic Pressure Cycling and Tests

Hydrostatic pressure cycling shall have 4 cycles. Each cycle shall consist of a 10 minute period at 1000 kPa followed by a 5 minute period at a pressure less than 350 kPa. The next cycle shall begin immediately following the completion of the previous cycle. Pressure rise and drop shall not exceed 690 kPa per minute. The pressure gauge shall be located and the pressure measured at the opposite end of the system from where the pressure is applied. After completion of the hydrostatic pressure cycling, the first hydrostatic pressure test shall be performed. During the first hydrostatic pressure test, the system shall be proven tight at a pressure of 1-1/2 times the working pressure up to 1000 kPa. This pressure shall be held for a minimum of 1 hour. The method of pressurizing the system shall be disconnected from the system before starting the 1 hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of pressure loss shall be determined, corrected and the hydrostatic pressure cycling and first hydrostatic pressure test shall be repeated until the system can hold the required pressure for at least 1 hour. After successful completion of the first hydrostatic pressure test, the water shall be drained out of the piping system and the piping system filled with treated water as defined in paragraph TREATED WATER for the remaining tests and for permanent operation of the system. The hydrostatic pressure cycling and tests shall be repeated after the system has been filled with treated water, using the same test conditions and criteria.

3.7.1.3 Operational Test

Operational test shall be performed on the complete system or testable portions thereof. The test shall be conducted with full design flows and operating temperatures in all runs of piping as if in service, to demonstrate satisfactory function and operating effectiveness. The

operational test will have two cycles. Each cycle shall consist of a 6-hour period with treated water in the system at the maximum operating temperature of 60 degrees C and maximum flow rate, and a period of at least 6-hours with no flow. The Contractor shall supply temporary pumps, piping connections, boilers, chillers and the gauges required to circulate the water at the desired temperatures and flow rates. Water shall be circulated through supply lines and returned through the return piping to demonstrate that the pressure drop is compatible with the flow rate and size of pipe and to show that obstructions do not exist in the piping system. Any unusual indicated pressure drop will be investigated and any obstructions removed. Any leaks found shall be repaired. After any obstructions have been removed and any leaks repaired, the operational test shall be repeated until successfully passed.

3.7.1.4 Final Hydrostatic Test

After successful completion of the operational test, the system shall be pressurized to 1-1/2 times the working pressure up to 1000 kPa. This pressure shall be held for a minimum of 4 hours. Means of pressurizing shall be disconnected prior to the start of the 4-hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of the pressure loss shall be determined, corrected, and all of the hydrostatic pressure cycling and tests repeated.

-- End of Section --

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DIVISION 02 - SITE WORK

SECTION 02630A

STORM-DRAINAGE SYSTEM

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SECTION 02630A

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges
AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 294	(1998) Corrugated Polyethylene Pipe, 300- to 1200- mm Diameter
AASHTO MP 7	(1997) Corrugated Polyethylene Pipe, 1350 and 1500 mm Diameter

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

AREMA Manual	(1999) Manual for Railway Engineering (4 Vol.)
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48M	(1994 el) Gray Iron Castings (Metric)
ASTM A 74	(1994) Cast Iron Soil Pipe and Fittings
ASTM A 276	(2003) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 536	(1999el) Ductile Iron Castings
ASTM A 716	(1995) Ductile Iron Culvert Pipe
ASTM B 26/B 26M	(1998) Aluminum-Alloy Sand Castings

ASTM C 12	(1998e1) Installing Vitrified Clay Pipe Lines
ASTM C 32	(1999e1) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 55	(1999) Concrete Brick
ASTM C 62	(1997a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76M	(1999a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 139	(1999) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 425	(1998b) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 700	(1999) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 789	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 850	(1998) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 Ft. of Cover Subjected to Highway Loadings
ASTM C 877M	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-One Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3350	(1998a) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(1995) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(1997) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile

Gravity Sewer Pipe and Fittings Based on
Controlled Inside Diameter

- | | |
|------------|---|
| ASTM F 894 | (1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe |
| ASTM F 949 | (1999) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- | | |
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| AWWA C105 | (1988) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids |
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-07 Certificates

- Resin Certification
- Pipeline Testing
- Determination of Density
- Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy

of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76M , Class IV or V.

2.1.2 Clay Pipe

Extra strength conforming to ASTM C 700.

2.1.3 Ductile Iron Culvert Pipe

ASTM A 716.

2.1.4 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.4.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the

requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.5 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.5.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 80 to 600 mm in diameter and maximum DR of 26 for pipes 650 to 1200 mm in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.5.2 Corrugated PE Pipe

AASHTO M 294, Type S, for pipes 300 to 1200 mm and AASHTO MP 7, Type S, for pipes 1350 to 1500 mm produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class in accordance with AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (mm)	Minimum Wall Area (square mm/m)	Minimum Moment of Inertia of Wall Section (mm to the 4th/mm)
300	3200	390
375	4000	870
450	4900	1020
600	6600	1900
750	8300	2670
900	9500	3640
1050	9900	8900
1200	10900	8900
1350	12000	13110
1500	13650	13110

2.1.5.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

Nominal Size (mm)	Minimum Wall Area (square mm/m)	Minimum Moment Of Inertia of Wall Section (mm to the 4th/mm)	
		Cell Class 334433C	Cell Class 335434C
450	6300	850	620
525	8800	1150	840
600	9900	1330	970
675	12500	2050	1490
750	12500	2050	1490
825	14800	2640	2160
900	17100	3310	2700
1050	16500	4540	3720
1200	18700	5540	4540

2.1.6 Cast Iron Soil Pipe and Fittings

Cast Iron Soil Pipe meeting the requirements of ASTM A 74, Class SV, shall be used for downspout drains if the minimum cover of 300mm (12 inches) in grassed areas cannot be met. Cast iron soil pipe and fittings shall be used if the minimum cover of 750mm (2-1/2 ft) in paved or traffic areas cannot be met. Minimum cover for cast iron soil pipe and fittings in paved areas shall be 450mm (18 inches). Cast iron soil pipe and fittings shall be as specified in Section 02531 SANITARY SEWERS. Pipe shall be encased with 8 mm thick polyethylene in accordance with AWWA C105.

2.2 DRAINAGE STRUCTURES

2.2.1 Precast Reinforced Concrete Box

For highway loadings with 600 mm of cover or more or subjected to dead load only, ASTM C 789; for less than 600 mm of cover subjected to highway loading, ASTM C 850.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 17 MPa (2500 psi) concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 3 to 6 percent. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 25 mm thick for covers and not less than 40 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 75 mm between steel

and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 21 liters of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 200 mm (8 inches) thick, not less than 200 mm (8 inches) long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 10 mm of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478M. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure or made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.7 Joints

2.3.7.1 Flexible Joints

- a. Materials: Flexible joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443M . Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 1.35 m (54 inches).
- b. Test Requirements: Flexible joints shall be tested and shall meet test requirements of PIPELINE TESTING.

2.3.7.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877M .

2.3.7.3 Flexible Gasketed Joints

- a. Gaskets: When exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 178 mm (7 inches) wide and approximately 10 mm (3/8 inch) thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 21 mm (13/16 inch) in diameter for pipe diameters of 914 mm (36 inches) or smaller and 22 mm (7/8 inch) in diameter for larger pipe having 13 mm (1/2 inch) deep end corrugation. Rubber O-ring gaskets shall be 35 mm (1-3/8 inches) in diameter for pipe having 25 mm (1 inch) deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443 . Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.
- b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.7.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.7.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.7.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-16, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

2.3.7.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.7.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 STAINLESS STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 1 m (3 feet). These ladders shall be not less than 406 mm (16 inches) in width, with 19 mm (3/4 inch) diameter rungs spaced 305 mm (12 inches) apart. The two stringers shall be a minimum 10 mm (3/8 inch) thick and 63 mm (2-1/2 inches) wide. Ladders and inserts shall be fabricated of AISI Type 304 stainless steel in conformance with ASTM A 276.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48M , Class 30B or 35B. Shape and size shall be as indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316a "Excavation, Trenching, and Backfilling for Utilities Systems" and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 600 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in

cost of stronger pipe or special installation procedures will be necessary.

Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with S4C materials compacted to 95% of max density as determined by ASTM D 1557 to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 200 mm or 13 mm for each meter of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 02316a "Excavation, Trenching, and Backfilling for Utilities Systems".

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with S4C material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Clay Pipe Requirements

Bedding for clay pipe shall be as specified by ASTM C 12.

3.2.3 Ductile Iron Pipe

Bedding for ductile iron pipe shall be as shown on the drawings.

3.2.4 Plastic Pipe

Plastic pipes shall have S4C bedding material placed 100mm (4 inch) below

the bottom of the pipe. Bedding shall be compacted to 95% of max density as determined by ASTM D 1557. Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Haunching, and initial backfill shall be either Class IB or II material.

S4C material shall consist of a granular material meeting the following gradation:

<u>Sieve Opening</u>	<u>Percent Passing (%)</u>
12.5 mm	100
9.5 mm	85-100
4.75 mm	10-30
2.36 mm	0-10
1.00 mm	0-5

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

<u>TYPE OF PIPE</u>	<u>MAXIMUM ALLOWABLE DEFLECTION (%)</u>
Plastic	7.5
Others	As recommended by manufacturer

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 Concrete, Clay, PVC, Ribbed PVC and Ductile Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.3.4 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Flexible Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, complete with frames and covers or gratings; and with fixed stainless steel ladders where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STAINLESS STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of stainless steel

inserts spaced not more than 1.83 m (6 feet) vertically, and shall be installed to provide at least 152 mm (6 inches) of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 150 millimeters. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 300 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 300 mm above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 150 mm.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels,

gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by exfiltration tests. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top

of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 36 mL per mm in diameter per 100 meters (0.8 gallons per inch in diameter per 100 feet) of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

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SECTION 02721A

SUBBASE COURSES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117 (1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 131 (1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (1996) Sieve Analysis of Fine and Coarse Aggregates

ASTM D 75 (1987; R 1997) Sampling Aggregates

ASTM D 422 (1963; R 1998) Particle-Size Analysis of Soils

ASTM D 1556 (1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 2922 (1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 4318 (1998) Liquid Limit, Plastic Limit, and

Plasticity Index of Soils

ASTM E 11

(1995) Wire-Cloth Sieves for Testing
Purposes

1.2 SUBMITTALS

SD-03 Product Data

Equipment

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and Testing

Copies of initial and in-place test results.

1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section 01455 CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with

ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with AASHTO T 180, Method D.

1.4.2.4 Density Tests

Density shall be field measured in accordance with ASTM D 1556 and ASTM D 2922. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

1.4.2.5 Wear Test

Wear tests shall be made on subbase course material in conformance with ASTM C 131.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

- a. Sieve Analysis including 0.02 mm size material
- b. Liquid limit and plasticity index moisture-density relationship
- c. Wear

1.4.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted subbase course. Samples shall be taken for each 1000 square meters of each layer of material placed in each area.

- a. Sieve Analysis including 0.02 mm size material
- b. Field Density
- c. Moisture liquid limit and plasticity index

1.4.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed

on samples taken from the completed and compacted subbase course.

1.5 WEATHER LIMITATIONS

Completed areas damaged by rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Subbase Course

Aggregates shall consist of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the 4.75 mm sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. Aggregate shall be reasonably uniform in density and quality. Aggregates shall have a maximum size of 75 mm and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3	No.4
2 mm	50	80	--	85
0.075 mm	15	15	15	15

Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested as determined in accordance with ASTM D 422. The portion of any blended component and of the completed course passing the 0.425 mm shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase course, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying

course or subgrade shall meet specified compaction and surface tolerances. Ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the subbase course is placed.

3.2 GRADE CONTROL

The finished and completed subbase course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.3 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the subbase material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.4 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 150 mm is specified, the material may be placed in a single layer; when a compacted thickness of more than 150 mm is required, no layer shall exceed 150 mm nor be less than 75 mm when compacted.

3.5 COMPACTION

Each layer of the subbase course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.6 PROOF ROLLING

Areas designated on the drawings to be proof rolled shall receive an

application of 30 coverages with a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 13.6 metric tons and inflated to a minimum of 1.035 MPa. A coverage is defined as the application of one tire print over the designated area. In the areas designated, proof rolling shall be applied to the top layer of the subbase course. Water content of the top layer of the subbase course shall be maintained such that the water content is within plus or minus 3 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. Any material in the subbase courses or underlying materials indicated to be unsatisfactory by the proof rolling shall be removed, dried, and recompact, or removed and replaced with satisfactory materials.

3.7 EDGES

Approved material shall be placed along the edges of the subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 300 mm width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

3.8 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 10 mm when tested with a 3.6 m (12 foot) straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.9 THICKNESS CONTROL

The completed thickness of the subbase course shall be in accordance with the thickness and grade indicated on the drawings. The thickness of each course shall be measured at intervals providing at least one measurement for each 400 square meters or part thereof of subbase course. The thickness measurement shall be made by test holes, at least 75 mm in diameter through the course. The completed subbase course shall not be more than 13 mm deficient in thickness nor more than 13 mm above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 13 mm or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 13 mm. The average job thickness shall be the average of the job measurements as specified above but within 6 mm of the thickness shown.

3.10 MAINTENANCE

The subbase course shall be maintained in a satisfactory condition until accepted.

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SECTION 02722A

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993e1) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996e1) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	(1988; R 1996e1) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

SD-06 Test Reports

Sampling and testing
Field Density Tests

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01455 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 2922. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in

accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.4.2.5 Wear Test

Wear tests shall be made on ABC course material in conformance with ASTM C 131.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis including 0.02 mm size material.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.

1.4.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square meters, or portion thereof, of completed area.
- b. Sieve Analysis including 0.02 mm size material shall be performed for every 500 metric tons, or portion thereof, of material placed.
- c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.4.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be

based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.5 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that portion passing the 4.75 mm sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 1045 kg/cubic meter as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces.

Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 38 mm and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
50.0 mm	100	----	----
37.5 mm	70-100	100	----
25.0 mm	45-80	60-100	100
12.5 mm	30-60	30-65	40-70
4.75 mm	20-50	20-50	20-50
2.00 mm	15-40	15-40	15-40
0.425 mm	5-25	5-25	5-25
0.075 mm	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.3 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in

areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300a EARTHWORK and Section 02721a SUBBASE COURSES. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.4 INSTALLATION

3.4.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.4.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 150 mm is required, the material shall be placed in layers of equal thickness. No layer shall exceed 150 mm or less than 75mm when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be

cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.4.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.4.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 1.5 m wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 600 mm width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.4.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.4.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 150 mm nor be less than 75 mm in compacted

thickness. The total compacted thickness of the ABC course shall be within 13 mm of the thickness indicated. Where the measured thickness is more than 13 mm deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 13 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 6 mm of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

3.4.7 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 13 mm or more below grade, then the top layer should be scarified to a depth of at least 75 mm and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.4.8 Smoothness

The surface of the top layer shall show no deviations in excess of 10 mm when tested with a 3.05 meter straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 15 meter intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.5 TRAFFIC

Traffic shall not be allowed on the completed ABC.

3.6 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.7 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as

directed. No additional payments will be made for materials that must be replaced.

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SECTION 02741A

HOT-MIX ASPHALT (HMA) FOR ROADS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO MP 2	(1998; Interim 1999) Superpave Volumetric Mix Design
AASHTO TP53	(1998; Interim 1999) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	(1997) Evaporable Total Moisture Content of Aggregate by Drying
ASTM C 1252	(1998) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(1998) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous

Paving Mixtures

ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985)) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(1995) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(1984; R 1994el) Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(1996el) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture
ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3381	(1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	(1999) Random Sampling of Construction Materials
ASTM D 3666	(1998) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	(1994el) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867/D 4867M	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate

ASTM D 6307 (1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASPHALT INSTITUTE (AI)

AI MS-2 (1997) Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526 (1978) Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171 (1995) Test Method for Determining Percentage of Crushed Particles in Aggregate

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design.

Proposed JMF.

Contractor Quality Control; G.

Quality control plan.

Material Acceptance and Percent Payment.

Acceptance test results and pay calculations.

SD-04 Samples

Asphalt Cement Binder.

20 L sample for mix design verification.

Aggregates.

Sufficient materials to produce 90 kg of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates.

QC Monitoring.

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder.

Copies of certified test data.

Testing Laboratory.

Certification of compliance.

Plant Scale Calibration Certification

1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.6.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.6.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade.

The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 9.14 m in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.

d. Laser control.

1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.8 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when weather conditions otherwise prevent the proper handling or finishing of the bituminous course.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, screenings, natural sand and mineral filler, as required. The portion of material retained on the 4.75 mm sieve is coarse aggregate. The portion of material passing the 4.75 mm sieve and retained on the 0.075 mm sieve is fine aggregate. The portion passing the 0.075 mm sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate or 12 percent when using sodium sulfate.

c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20% percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. All individual fine aggregate sources shall have a sand equivalent value not less than 45 when tested in accordance with ASTM D 2419.

The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 43.0 percent when tested in accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

<u>Sieve Size, mm</u>	Gradation 2 Percent Passing by <u>Mass</u>
25.0	---
19.0	100
12.5	76-96
9.5	69-89
4.75	53-73
2.36	38-60
1.18	26-48
0.60	18-38
0.30	11-27
0.15	6-18
0.075	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade AR-60. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement

specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 90 kg of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

At the option of the contractor a currently used DOT superpave hot mix may be used in lieu of developing a new hot mix design study as described herein. The superpave volumetric mix shall be designed in accordance with AASHTO MP 2.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hammer per side of molded specimen.
- f. Laboratory mixing temperature.
- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.
- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots of stability, flow, air voids, voids in the

mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.
- m. Percent particles with 2 or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.
- o. Percent flat or elongated particles (in coarse aggregate).
- p. Tensile Strength Ratio(TSR).
- q. Antistrip agent (if required) and amount.
- r. List of all modifiers and amount.
- s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

<u>Test Property</u>	<u>75 Blow Mix</u>	
Stability, newtons minimum	*8000	
Flow, 0.25 mm	8-16	
Air voids, percent	3-5	
Percent Voids in mineral aggregate (VMA), (minimum)		
Gradation 1	13.0	
Gradation 2	14.0	
Gradation 3	15.0	
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory jmf design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 4. Field (Plant) Established JMF Tolerances
Sieves Adjustments (plus or minus), percent

12.5 mm	3
4.75 mm	3
2.36 mm	3
0.075 mm	1
Binder Content	0.4

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; while not desirable, this is acceptable.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C when added to the aggregates. Modified asphalts shall be no more than 174 degrees C when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 175 degrees C when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory

mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used.

The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 75 - 150 m long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 5. Test Section Requirements for Material and Mixture Properties

<u>Property</u>	<u>Specification Limit</u>
Aggregate Gradation-Percent Passing (Individual Test Result)	
4.75 mm and larger	JMF plus or minus 8

Table 5. Test Section Requirements for Material and Mixture Properties

<u>Property</u>	<u>Specification Limit</u>
2.36, 1.18, 0.60, and 0.30 mm	JMF plus or minus 6
0.15 and 0.075 mm	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	14 minimum
Stability, newtons (Average of 3 specimens)	4450 minimum
Flow, 0.25 mm (Average of 3 specimens)	8 - 16
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 60 degrees C. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 3 m. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 300 mm; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 3 m from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 3 m. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall

be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 50 mm from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning

- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. The laboratory shall meet the requirements as required in ASTM D 3666. The effective working area of the laboratory shall be a minimum of 14 square meters with a ceiling height of not less than 2.3 m. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 24 degrees C plus or minus 2.3 degrees C. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT) by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53 or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at

the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 50 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

(Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts)

Parameter to be Plotted	Running Average of Individual Samples		Last Four Samples	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
4.75 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
0.6 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
0.075 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, newtons (minimum)				
75 Blow JMF	8000	7560	8440	8000
50 Blow JMF	4450	4000	4900	4450
Flow, 0.25 mm				
75 Blow JMF	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 Blow JMF	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment)			

3.11 MATERIAL ACCEPTANCE AND PERCENT PAYMENT

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Test results and payment calculations

shall be forwarded daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis.

A standard lot for all requirements will be equal to 4 hours of production. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Percent Payment

When a lot of material fails to meet the specification requirements for 100 percent pay as outlined in the following paragraphs, that lot shall be removed and replaced, or accepted at a reduced price which will be computed by multiplying the unit price by the lot's pay factor. The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, grade or smoothness (each discussed below). At the end of the project, an average of all lot pay factors will be calculated. If this average lot pay factor exceeds 95.0 percent, then the percent payment for the entire project will be 100 percent of the unit bid price. If the average lot pay factor is less than 95.0 percent, then each lot will be paid for at the unit price multiplied by the lot's pay factor. For any lots which are less than 2000 metric tons, a weighted lot pay factor will be used to calculate the average lot pay factor.

3.11.2 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D 1559. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.3 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.4 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726 and determining the theoretical maximum density of every other subplot sample using ASTM D 2041.

Laboratory air void calculations for each subplot will use the latest theoretical maximum density values obtained, either for that subplot or the previous subplot. The mean absolute deviation of the four laboratory air void contents (one from each subplot) from the JMF air void content will be evaluated and a pay factor determined from Table 7. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

3.11.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each subplot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

$$\text{Mean Absolute Deviation} = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4$$

$$= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 7 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 7. Pay Factor Based on Laboratory Air Voids

Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, %
0.60 or less	100
0.61 - 0.80	98
0.81 - 1.00	95
1.01 - 1.20	90
Above 1.20	reject (0)

3.11.6 In-place Density

3.11.6.1 General Density Requirements

For determining in-place density, one random core will be taken by the Government from the mat (interior of the lane) of each subplot, and one random core will be taken from the joint (immediately over joint) of each subplot. Each random core will be full thickness of the layer being placed.

When the random core is less than 25 mm thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.6.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage

of the average Marshall density for the lot. The Marshall density for each lot will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). The average in-place mat density and joint density for a lot are determined and compared with Table 8 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 8. The area associated with the joint is then determined and will be considered to be 3 m wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the Marshall density on both sides of a longitudinal joint is different, the average of these two densities will be used as the Marshall density needed to calculate the percent joint density. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 8. Pay Factor Based on In-place Density

Average Mat Density (4 Cores)	Pay Factor, %	Average Joint Density (4 Cores)
97.9 or 100	100.0	96.4 or above
97.8 or 100.1	99.9	96.3
97.7	99.8	96.2
97.6 or 100.2	99.6	96.1
97.5	99.4	96.0
97.4 or 100.3	99.1	95.9
97.3	98.7	95.8
97.2 or 100.4	98.3	95.7
97.1	97.8	95.6
97.0 or 100.5	97.3	95.5
96.9	96.3	95.4
96.8 or 100.6	94.1	95.3
96.7	92.2	95.2
96.6 or 100.7	90.3	95.1
96.5	87.9	95.0
96.4 or 100.8	85.7	94.9
96.3	83.3	94.8
96.2 or 100.9	80.6	94.7
96.1	78.0	94.6
96.0 or 101.0	75.0	94.5
below 96.0 or above 101.0	0.0 (reject)	below 94.5

3.11.6.3 Pay Factor Based on In-place Density

An example of the computation of a pay factor (in I-P units only) based on

in-place density, is as follows: Assume the following test results for field density made on the lot: (1) Average mat density = 97.2 percent (of lab density). (2) Average joint density = 95.5 percent (of lab density). (3) Total area of lot = 30,000 square feet. (4) Length of completed longitudinal construction joint = 2000 feet.

a. Step 1: Determine pay factor based on mat density and on joint density, using Table 8:

Mat density of 97.2 percent = 98.3 pay factor.

Joint density of 95.5 percent = 97.3 pay factor.

b. Step 2: Determine ratio of joint area (length of longitudinal joint x 10 ft) to mat area (total paved area in the lot): Multiply the length of completed longitudinal construction joint by the specified 10 ft. width and divide by the mat area (total paved area in the lot).

$(2000 \text{ ft.} \times 10 \text{ ft.}) / 30000 \text{ sq.ft.} = 0.6667$ ratio of joint area to mat area (ratio).

c. Step 3: Weighted pay factor (w_{pf}) for joint is determined as indicated below:

$w_{pf} = \text{joint pay factor} + (100 - \text{joint pay factor}) (1 - \text{ratio})$
 $w_{pf} = 97.3 + (100 - 97.3) (1 - 0.6667) = 98.2\%$

d. Step 4: Compare weighted pay factor for joint density to pay factor for mat density and select the smaller:

Pay factor for mat density: 98.3%. Weighted pay factor for joint density: 98.2%

Select the smaller of the two values as pay factor based on density:
98.2%

3.11.7 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 15 mm from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 7.6 m , or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, the Contracting Officer will inform the Contractor in writing, of the results of the grade-conformance tests. When more than 5 percent of all measurements made within a lot are outside the 15 mm tolerance, the pay factor based on

grade for that lot will be 95 percent. In areas where the grade exceeds the tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.8 Surface Smoothness

The Contractor shall use both of the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 60 m in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.8.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 6 mm or more, and all pavements shall be within the tolerances specified in Table 9 when checked with an approved 4 m straightedge.

Table 9. Straightedge Surface Smoothness--Pavements

<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Tolerance, mm</u>
All paved areas	Longitudinal	6
	Transverse	6

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 3 mm or more, and all pavement shall have a Profile Index not greater than specified in Table 10 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 60 m, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 10. Profilograph Surface Smoothness--Pavements

<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Maximum Specified Profile Index (mm/km)</u>
All Paved Areas	Longitudinal	140

3.11.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the

Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 8 m or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 6.1 m and at the third points for lanes 6.1 m or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 5 mm wide and the "bump template" shall span 25 mm with an offset of 10 mm. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

3.11.8.3 Payment Adjustment for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When between 5.0 and 10.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph Smoothness Requirements above, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness, will be 95 percent. When more than 10.0 percent of all measurements exceed the tolerance, the computed pay factor will be 90 percent. When between 15.0 and 20.0 percent of all measurements exceed the tolerance, the computed pay factor will be 75 percent. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index of a lot exceeds the tolerance specified in paragraph Smoothness Requirements above by 16 mm/km, but less than 32 mm/km, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 32 mm/km, but less than 47 mm/km, the computed pay factor

will be 90 percent. When the Profile Index exceeds the tolerance by 47 mm/km , but less than 63 mm/km, the computed pay factor will be 75 percent. When the Profile Index exceeds the tolerance by 63 mm/km or more, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 79 mm/km or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 10 mm in height shall be reduced by diamond grinding until they do not exceed 7.5 mm when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

-- End of Section --

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SECTION 02748A

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SECTION 02748A

BITUMINOUS TACK AND PRIME COATS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 82 (1975; R 1996) Cut-Back Asphalt
(Medium-Curing Type)

AASHTO T 40 (1978; R 1996) Sampling Bituminous
Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140 (200) Sampling Bituminous Materials

ASTM D 977 (1998) Emulsified Asphalt

ASTM D 2027 (1976; R 1997) Cutback Asphalt
(Medium-Curing Type)

ASTM D 2995 (1999) Determining Application Rate of
Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

SD-06 Test Reports

Sampling and Testing

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 977, Grade SS-1 or SS-1h.

2.2 PRIME COAT

Emulsified asphalt shall conform to ASTM D 2027, AASHTO M 82, Grade MC-30 or MC-70.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.20 liter nor more than 0.70 liter per square meter of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.70 liter nor more than 1.80 liters per square meter of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

MC-30	29-87 degrees C
MC-70	50-107 degrees C

Emulsions

SS-1	20-70 degrees C
SS-1h	20-70 degrees C

*These temperature ranges exceed the flash point of the material and care

should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 8 meters of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished

the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 30 meters for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.20 liters per square meter . Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 1.10 liters per square meter . Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

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SECTION 02763A

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 792	(1998) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 4280	(1996) Extended Life Type, Nonplowable, Prismatic, Raised, Retroreflective Pavement Markers
ASTM E 28	(1999) Softening Point of Resins by Ring and Ball Apparatus

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952	(Rev D; Canc. Notice 1) Paint, Traffic and Airfield Marking, Waterborne (Metric)
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-06 Test Reports

Sampling and Testing

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking compound or paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.3 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.4 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.4.1 Paint Application Equipment

The equipment to apply paint to parking stall (where indicated) pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 8 kilometers per hour (5 mph), and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical

agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.4.2 Thermoplastic Application Equipment

1.4.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.4.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.4.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is

capable of hot applying thermoplastic by the extrusion method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 190 degrees C (375 degrees F), at widths varying from 75 to 300 mm (3 to 12 inches) and in thicknesses varying from 1.0 to 5.0 mm (0.020 to 0.190 inch) and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 6 kilometers (20,000 lineal feet) of longitudinal markings in an 8-hour day.

(1) The mobile unit shall be equipped with a melting kettle which holds a minimum of 2.7 metric tons (6000 pounds) of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 195 to 220 degrees C (375 to 425 degrees F).

A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle. The mobile unit shall be equipped with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 195 to 220 degrees C (375 to 425 degrees F); and shall be capable of extruding a line of 75 to 200 mm (3 to 8 inches) in width; and at a thickness of not less than 3 mm (0.125 inch) nor more than 5.0 mm (0.190 inch), and of generally uniform cross section.

(2) The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal meters (feet) of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 195 to 220 degrees C (375 to 425 degrees F), of extruding a line of 75 to 300 mm (3 to 12 inches) in width, and in thicknesses of not less than 3.0 mm (0.125 inch) nor more than 5.0 mm (0.190 inch) and of generally uniform cross section.

1.4.3 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be

capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.4.4 Surface Preparation Equipment

1.4.4.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 70.8 liters per sec (150 cfm) of air at a pressure of not less than 620 kPa (90 psi) at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.4.4.2 Waterblast Equipment

The water pressure shall be specified at 17.9 MPa (2600 psi) at 60 degrees C (140 degrees F in order to adequately clean the surfaces to be marked.

1.4.5 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.4.5.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.4.5.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.4.6 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.5 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

PART 2 PRODUCTS

2.1 PAINT FOR BLUE HANDICAP STALL MARKINGS AND WHITE CATCH BASIN MARKINGS

Paint shall be used for blue handicap stall markings and white catch basin markings only. All other markings shall be thermoplastic materials. The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for handicap space markings and catch basin markings shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District. Blue pavement marking paint shall be Pervo Paint Company #3033 Dark Handicap Blue Traffic Line Paint, water base, or approved equal.

2.2 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads,	20 min.	20 min.
Calcium carbonate & inert fillers	49 max.	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated.

2.2.2.2 Drying Time

When installed at 20 degrees C) and in thicknesses between 3 and 5 mm, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 90 degrees C (194 degrees F) when tested in accordance with ASTM E 28.

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic compound (VOC). Solids content shall not be less than 10 percent by weight at 20 degrees C and 60 percent relative humidity. A wet film thickness of 0.10 mm plus or minus 0.025 mm, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 liter sample of the primer material.

2.3 RAISED REFLECTIVE MARKERS

Two-way reflective raised pavement markers shall be the prismatic type. Markers shall be of permanent colors, as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Two-way reflective raised pavement markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 19 mm above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D 4280.

2.4 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

All new pavement surfaces shall be at least 30 days old before applying paint. Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to

rain.

3.1.1 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.2 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

- a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
- b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
- c. All remaining curing compound is intact; all loose and flaking material is removed.
- d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
- e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

Pavement marking types shall be as follows:

<u>Marking description</u>	<u>Type of pavement marking</u>
Roads (new & repaved)	Double yellow Thermoplastic w/ prismatic reflectors
Road--Edge lines	White Thermoplastic markings
Cross-walks	White Thermoplastic markings

Parking stall striping & related markings (e.g. H/C, compact, etc.)	Thermoplastic Markings, color as markings indicated, except blue H/C may be painted
Pavement arrows (roads & parking)	White Thermoplastic markings
Parking Driveways (roads leading to Parking lots)	Single yellow Thermoplastic markings

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 5 degrees C and less than 35 degrees C. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint.

Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 2.9 plus or minus 0.5 square meter per liter. Glass spheres shall be applied uniformly to the wet paint on road and street pavement at a rate of 0.7 plus or minus 0.06 kilograms of glass spheres per liter of paint.

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 2.9 plus or minus 0.5 square meter per liter.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 5 degrees C and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt and/or concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes. The Portland cement concrete primer shall be allowed to dry in accordance with the thermoplastic manufacturer's recommendations. To shorten the curing time of the epoxy resins an infrared heating device may be used on the concrete primer.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.10 mm (0.005 inch), plus or minus 0.025 mm (0.001 inch) 25-40 square meters per liter.

b. Portland Cement Concrete Primer: Primer shall be applied to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 1.0 to 1.3 mm 30-40 square meters per liter.

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 190 degrees C nor higher than 220 degrees C at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 3.0 mm (0.125 inch) nor more than 5.0 mm (0.190 inch).

b. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 kilogram per 2 square meters of compound.

3.2.3 Raised Reflective Markers

Prefabricated markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. To insure good bond, pavement in areas where markers will be set shall be thoroughly cleaned by sandblasting and use of compressed air prior to applying adhesive.

3.2.4 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

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SECTION 02770A

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain,
for Concrete Reinforcement

ASTM A 615/A 615M (1996a) Deformed and Plain Billet-Steel
Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996a) Rail-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM A 617/A 617M (1996a) Axle-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM C 31/C 31M (1996) Making and Curing Concrete Test
Specimens in the Field

ASTM C 143 (1990a) Slump of Hydraulic Cement Concrete

ASTM C 171 (1997) Sheet Materials for Curing Concrete

ASTM C 172 (1997) Sampling Freshly Mixed Concrete

ASTM C 173 (1996) Air Content of Freshly Mixed
Concrete by the Volumetric Method

ASTM C 309 (1997) Liquid Membrane-Forming Compounds
for Curing Concrete

ASTM C 920 (1995) Elastomeric Joint Sealants

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint

Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

- ASTM D 1752 (1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- ASTM D 3405 (1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 12 hours of completion of the test.

Equipment Calibration

Submit copy of concrete compression machine calibration, air content calibration, and thermometer calibration. Except for the concrete compression machine, all calibration shall be performed within 30 calendar days of the first field visit.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C (85 degrees F) except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 35 degrees C (95 degrees F) at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 21 Mpa (3000 psi) at 28 days for curbs and gutters. Concrete shall have a minimum compressive strength of 17 Mpa (2500 psi) at 28 days for walks. Maximum size of aggregate shall be 37.5 mm.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 3 to 6 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 50 mm plus or minus 25 mm where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M, ASTM A 616/A 616M, or ASTM A 617/A 617M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 Clear Membrane-Forming Curing Compound

Clear membrane-forming curing compound with fugitive dye shall conform to ASTM C 309, Type 2.

2.3 JOINT FILLER STRIPS

2.3.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.3.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 10 mm thick, unless otherwise indicated.

2.4 JOINT SEALANTS

2.4.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.4.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.5 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 50 mm nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 3 m. Radius bends may be formed with 19 mm boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 3 m with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.5.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.5.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface,

provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 02300a EARTHWORK.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 meters. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 3 mm in any 3 m long section. After forms are set, grade and alignment shall be checked with a 3 m straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway, unless otherwise indicated. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 3 mm. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 8 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 13 mm. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 6 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 1.5 m on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 3 m or more in width. Transverse expansion joints shall be installed at intervals not exceeding 12 m (40 feet) and at sidewalk returns. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 3 mm blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 10 mm joint filler strips. Joint

filler shall be placed with top edge 6 mm below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3 mm, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 1.5 m nor greater than 4.5 m in length. Contraction joints shall be constructed by means of 3 mm thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 13 mm in width shall be provided at intervals not exceeding 12 meters. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 25 mm depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces

of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 150 mm. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm when a continuous sheet is not used. The curing medium shall not be less than 450 mm wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of clear membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters per liter (200 square feet per gallon) for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy

rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 11 square meters per liter (50 square yards per gallon) for first application and not more than 15.5 square meters per liter (70 square yards per gallon) for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 10 degrees C.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing.

Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed

concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine.

If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 6 mm. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

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SECTION 02811A

UNDERGROUND SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 32	(1996) Solder Metal
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM F 441/F 441M	(1999) Chlorinated Poly(Vinyl Chloride).(CPVC) Plastic Pipe, Schedules 40 and 80

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- ASSE 1012 (1995) Backflow Preventers with Intermediate Atmospheric Vent
- ASSE 1013 (1999) Reduced Pressure Principle Backflow Preventers

AMERICAN WATER WORKS ASSOCIATION(AWWA)

- AWWA C509 (1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service
- AWWA C901 (1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service

ASME INTERNATIONAL (ASME)

- ASME B1.2 (1983; R 1991; Errata May 1992) Gages and Gaging for Unified Inch Screw Threads
- ASME B16.15 (1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
- ASME B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
- ASME B16.22 (1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

- FCCCHR-CCC Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA ICS 2 (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
- NEMA ICS 6 (1993) Industrial Control and Systems,

Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1992) Water Hammer Arresters

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-51145 (Rev C) Flux, Soldering, Non-Electronic,
Paste and Liquid

1.2 PERFORMANCE REQUIREMENTS

System shall operate with a minimum water pressure of 689 kPa at connection to backflow prevention device and 207 kPa at the last head in each zone for spray heads, and 390 kPa for rotary heads.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sprinkler System

Detail drawings for valves, sprinkler heads, backflow preventers, automatic controllers, emitter heads, and water hammer arresters. Drawings shall include a complete list of equipment and materials, and manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed system layout, type and number of heads and emitters, zone valves, drain pockets, backflow devices, controllers, and mounting details of controllers. As-built Drawings which provide current factual information showing locations of mains, heads, valves, and controllers including deviations from and amendments to the drawings and changes in the work shall be included.

SD-03 Product Data

Framed Instructions

Labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Field Training

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules and notification of training.

Sprinkler System

Detailed procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done.

Spare Parts

Spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Design Analysis and Calculations

Design analyses and pressure calculations verifying that system will provide the irrigation requirements.

SD-06 Test Reports

Field Tests

Performance test reports, in booklet form, showing all field tests performed to adjust each component; and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of control valves.

SD-07 Certificates

Sprinkler System

The material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply.

SD-10 Operation and Maintenance Data

Sprinkler System

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout, simplified wiring and control diagrams of the system as installed, and system programming schedule.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather; excessive humidity and temperature variation; direct sunlight (in the case of plastic or rubber materials); and dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer who has produced similar systems which have performed well for a minimum period of 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Extra Stock

The following extra stock shall be provided: Two sprinkler heads of each size and type, two valve keys for operating manual valves, two wrenches for removing and installing each type of head, two quick coupler keys and hose swivels, and four irrigation controller housing keys.

2.2 PIPING MATERIALS

2.2.1 Copper Tubing and Associated Fittings

Tubing shall conform to requirements of ASTM B 88M , Type K. Fittings shall conform to ASME B16.22 and ASME B16.18, solder joint. Solder shall conform to ASTM B 32 95-5 tin-antimony. Flux shall conform to CID A-A-51145, Type I.

2.2.2 Red Brass Pipe and Associated Fittings

Pipe shall conform to requirements of ASTM B 43, regular. Fittings shall be Class 250, cast bronze threaded conforming to the requirements of ASME B16.15.

2.2.3 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

2.2.3.1 PVC Pipe

Pipe shall conform to the requirements of ASTM D 1785, PVC 1120 Schedule 40, 80; or ASTM D 2241, PVC 1120 SDR 21, Class 200.

2.2.3.2 PVC Fittings

Solvent welded socket type fittings shall conform to requirements of ASTM D 2466, Schedule 40. Threaded type fittings shall conform to requirements of ASTM D 2464, Schedule 80.

2.2.3.3 Solvent Cement

Solvent cement shall conform to the requirements of ASTM D 2564.

2.2.4 Polyethylene (PE) Plastic Piping

Pipe shall conform to AWWA C901, outside diameter base with dimension ratio (DR) of 9.3 to provide 1034 kPa (150 psi) minimum pressure rating. Fittings shall conform to ASTM D 3261, DR of 9.3.

2.2.5 Dielectric Fittings

Dielectric fittings shall conform to ASTM F 441/F 441M, Schedule 80, CPVC threaded pipe nipples, 100 mm (4 inch) minimum length.

2.3 SPRINKLER HEADS

2.3.1 Pop-Up Spray Heads

2.3.1.1 General Requirements

Pop-up spray heads lay flush with housing, then pop up when water pressure 138 kPa is activated in system. The rising member supporting the nozzle shall be identical on full, half, third or quarter pattern sprinklers so that nozzles will be interchangeable. The sprinkler head shall be designed to be adjustable for coverage and flow. The nozzle shall be removable so head does not have to be removed for flushing or cleaning. Nozzle rises a minimum of 100 mm (4 inches) above the body. The body shall be

constructed with a 13 mm female thread for installation in a fixed underground pipe system.

2.3.1.2 Shrubbery Sprinkler Heads

Sprinkler heads shall be conical spray with adjustable or non-adjustable coverage and designed for permanent aboveground mounting on riser or pop-ups at a height compatible with ground covers. Provide brass nozzles.

2.3.2 Rotary Pop-Up Sprinklers

Sprinklers shall be capable of covering 11m diameter at 3.90 kPa with a distribution rate of 7.5 L/second 75 mm pop-up, trajectory of 25 degrees, and maximum height of spray of 3 m. Construction shall be high impact molded plastic with filter screen, reducible watering radius, and choice of 8 nozzles and have adjustable radius capabilities.

2.3.3 Bubbler Sprinkler Heads

Heads shall be multiple-spray bubbler with adjustable flow and designed for permanent aboveground mounting on risers.

2.4 VALVES

2.4.1 Gate Valves, Less than 80 mm (3 Inches)

Gate valves shall conform to the requirements of MSS SP-80, Type 1, Class 150, threaded ends.

2.4.2 Gate Valves, 80 mm (3 Inches) and Larger

Gate valves shall conform to the requirements of AWWA C509 and have encapsulated resilient wedge, parallel seats, non-rising stems, and open by counterclockwise turning. End connections shall be flanged. Interior construction of valves shall be bronze including stem containing a maximum 2 percent aluminum and maximum 16 percent zinc.

2.4.3 Quick Coupling Valves

Quick coupling valves shall have brass parts and shall be two-piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutdown of main. Lids shall be lockable vinyl with spring for positive closure on key removal.

2.4.4 Remote Control Valves, Electrical

Remote control valves shall be solenoid actuated globe valves of 20 to 80 mm (3/4 to 3 inch) size, suitable for 24 volts, 60 cycle, and designed to provide for shut-off in event of power failure. Valve shall be cast bronze or brass or plastic housing suitable for service at 1034 kPa (150 psi) operating pressure with external flow control adjustment for shut-off capability, external plug at diaphragm chamber to enable manual operation, filter in control chamber to prevent valve body clogging with debris,

durable diaphragm, and accessibility to internal parts without removing valve from system.

2.4.5 Backflow Preventers

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-CCC.

Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013.

2.4.5.1 Reduced Pressure Type Backflow Preventers

Backflow preventers shall be Class 150 flanged bronze mounted gate valve and strainer, 304 stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 70 kPa (10 psi) at rated flow. Piping shall be red brass pipe and fittings. Strainers shall be bronze or brass construction with gasket caps. Units shall have 200-mesh stainless steel screen elements.

2.5 ACCESSORIES AND APPURTENANCES

2.5.1 Valve Keys for Manually Operated Valves

Valve keys shall be 15 mm (1/2 inch) diameter by 1000 mm long, tee handles and keyed to fit valves.

2.5.2 Valve Boxes and Concrete Pads

2.5.2.1 Valve Boxes

Valve boxes shall be cast iron, plastic lockable, or precast concrete for each gate valve, manual control valve and remote control valve. Box sizes shall be adjustable for valve used. Word "IRRIGATION" shall be cast on cover. Shaft diameter of box shall be minimum 130 mm (5-1/4 inches). Cast iron box shall have bituminous coating.

2.5.2.2 Concrete Pads

Concrete pads shall be precast or cast-in-place reinforced concrete construction for reduced pressure type backflow preventers.

2.5.3 Pressure Gauges

Pressure gauges shall conform to requirements of ASME B40.1, single style pressure gauge for water with 115 mm (4-1/2 inch) dial brass or aluminum case, bronze tube, gauge cock, pressure snubber, and siphon. Scale range shall be suitable for irrigation sprinkler systems.

2.5.4 Service Clamps

Service clamps shall be bronze flat, double strap, with neoprene gasket or "O"-ring seal.

2.5.5 Water Hammer Arresters

Water hammer arrester shall conform to the requirements of PDI WH 201; stainless steel construction with an encased and sealed bellows compression chamber.

2.6 AUTOMATIC CONTROLLERS, ELECTRICAL

Controller shall conform to the requirements of NEMA ICS 2 with 120-volt single phase service, operating with indicated stations, and grounded chassis. Enclosure shall conform to NEMA ICS 6 Type 3R, with locking hinged cover, wall-mounted. Controller shall be programmed for various schedules by setting switches and dials equipped with the following features: A switch for each day of week for two schedules, allowing each station to be scheduled individually as to days of watering; a minute switch for each station with a positive increment range of 3 to 60 minutes, set time within one percent; a switch allowing selected schedules to be repeated after each completion of initial watering schedule and allowing each operation to be scheduled throughout a 24-hour day; a circuit breaker for surge protection; and circuit for a 9-volt rechargeable NiCad battery.

2.7 ELECTRICAL WORK

Wiring and rigid conduit for electrical power shall be in accordance with NFPA 70, and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.8 CONCRETE MATERIALS

Concrete shall have a compressive strength of 17 MPa at 28 days as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.9 WATER SUPPLY MAIN MATERIALS

Tapping sleeves, service cut off valves, and connections to water supply mains shall be in accordance with Section 02510a WATER DISTRIBUTION SYSTEM.

2.10 INSULATING JOINTS

Insulating joints and dielectric fittings shall be in accordance with Section 02510a WATER DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 INSTALLATION

Sprinkler system shall be installed after site grading has been completed. Excavation, trenching, and backfilling for sprinkler system shall be in accordance with the applicable provisions of Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

3.1.1 Trenching

Trench around roots shall be hand excavated to pipe grade when roots of 50

mm diameter or greater are encountered. Trench width shall be 100 mm minimum or 1-1/2 times diameter of pipe, whichever is wider. Backfill shall be hand tamped over excavation. When rock is encountered, trench shall be excavated 100 mm deeper and backfilled with silty sand (SM) or well-graded sand (SW) to pipe grade. Trenches shall be kept free of obstructions and debris that would damage pipe. Subsoil shall not be mixed with topsoil. Existing concrete walks, drives and other obstacles shall be bored at a depth conforming to bottom of adjacent trenches. Pipe sleeves for bored pipe shall be two pipe diameters larger than sprinkler pipe.

3.1.2 Piping System

3.1.2.1 Cover

Underground piping shall be installed to meet the minimum depth of backfill cover specified.

3.1.2.2 Clearances

Minimum horizontal clearances between lines shall be 100 mm for pipe 50 mm (2 inches) and less; 300 mm for 65 mm (2-1/2 inches) and larger. Minimum vertical clearances between lines shall be 25 mm.

3.1.2.3 Minimum Slope

Minimum slope shall be 50 mm per 10 m in direction of drain valves.

3.1.3 Piping Installation

3.1.3.1 Polyvinyl Chloride (PVC) Pipe

a. Solvent-cemented joints shall conform to the requirements of ASTM D 2855.

b. Threaded joints shall be full cut with a maximum of three threads remaining exposed on pipe and nipples. Threaded joints shall be made tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.

c. Piping shall be joined to conform with requirements of ASTM D 2774 or ASTM D 2855, and pipe manufacturer's instructions. Pipe shall be installed in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Pipes shall be installed at temperatures over 5 degrees C.

3.1.3.2 Soldered Copper Tubing

Pipe shall be reamed and burrs removed. Contact surfaces of joint shall be cleaned and polished. Flux shall be applied to male and female ends. End of tube shall be inserted into fittings full depth of socket. After soldering, a solder bead shall show continuously around entire joint circumference. Excess acid flux shall be removed from tubings and fittings.

3.1.3.3 Threaded Brass Pipe

Prior to installation, pipe shall be reamed. Threads shall be cut in conformance with ASME B1.2. Pipe joint compound shall be applied to male end only.

3.1.3.4 Insulating Joints

Insulating and dielectric fittings shall be provided where pipes of dissimilar metal are joined and at connections to water supply mains as shown. Installation shall be in accordance with Section 02510a WATER DISTRIBUTION SYSTEM.

3.1.4 Installation of Valves

3.1.4.1 Manual Valves

Valves shall be installed in a valve box extending from grade to below valve body, with a minimum of 100 mm cover measured from finish grade to top of valve stem.

3.1.4.2 Automatic Valves

Valve shall be set plumb in a valve box extending from grade to below valve body, with minimum of 100 mm cover measured from grade to top of valve. Automatic valves shall be installed beside sprinkler heads with a valve box.

3.1.5 Sprinklers and Quick Coupling Valves

Sprinklers and valves shall be installed plumb and level with terrain.

3.1.6 Backflow Preventers

Backflow preventer shall be installed in new connection to existing water distribution system, between connection and control valves. Backflow preventer shall be installed with concrete pads.

3.1.6.1 Reduced Pressure Type

Pipe lines shall be flushed prior to installing reduced pressure device; device shall be protected by a strainer located upstream. Device shall not be installed in pits or where any part of device could become submerged in standing water.

3.1.7 Control Wire and Conduit

3.1.7.1 Wires

Low voltage wires may be buried beside pipe in same trench. Rigid conduit shall be provided where wires run under paving. Wires shall be number tagged at key locations along main to facilitate service. One control circuit shall be provided for each zone and a circuit to control sprinkler system.

3.1.7.2 Loops

A 300 mm loop of wire shall be provided at each valve where controls are connected.

3.1.7.3 Expansion and Contraction

Multiple tubes or wires shall be bundled and taped together at 6 m intervals with 300 mm loop for expansion and contraction.

3.1.7.4 Splices

Electrical splices shall be waterproof.

3.1.8 Automatic Controller

Exact field location of controllers shall be determined before installation. Coordinate the electrical service to these locations. Install in accordance with manufacturer's recommendations and NFPA 70.

3.1.9 Thrust Blocks

Concrete shall be placed so that sides subject to thrust or load are against undisturbed earth, and valves and fittings are serviceable after concrete has set. Thrust blocks shall be as specified in Section 02510a WATER DISTRIBUTION SYSTEM.

3.1.10 Backfill

3.1.10.1 Minimum Cover

Depth of cover shall be as shown on plans. Remainder of trench or pipe cover shall be filled to within 80 mm of top with excavated soil, and compact soil with plate hand-held compactors to same density as undisturbed adjacent soil.

3.1.10.2 Restoration

Top 150 mm shall be filled with topsoil and compacted with same density as surrounding soil. Lawns and plants shall be restored in accordance with Sections 02921a SEEDING and Section 02930a EXTERIOR PLANTING.

3.1.11 Adjustment

After grading, seeding, and rolling of planted areas, sprinkler heads shall be adjusted flush with finished grade. Adjustments shall be made by providing new nipples of proper length or by use of heads having an approved device, integral with head, which will permit adjustment in height of head without changing piping.

3.1.12 Disinfection

Sprinkler system fed from a potable water system shall be disinfected upstream of backflow preventer in accordance with Section 02510a WATER DISTRIBUTION SYSTEM.

3.1.13 Cleaning of Piping

Prior to the hydrostatic and operation tests, the interior of the pipe shall be flushed with clean water until pipe is free of all foreign materials. Flushing and cleaning out of system pipe, valves, and components shall not be considered completed until witnessed and accepted by Contracting Officer.

3.2 FIELD TESTS

All instruments, equipment, facilities, and labor required to conduct the tests shall be provided by Contractor.

3.2.1 Hydrostatic Pressure Test

Piping shall be tested hydrostatically before backfilling and proved tight at a hydrostatic pressure of 1034 kPa (150 psi) without pumping for a period of one hour with an allowable pressure drop of 35 kPa (5 psi). If hydrostatic pressure cannot be held for a minimum of 4 hours, Contractor shall make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Contracting Officer.

3.2.2 Leakage Tests

Leakage tests for service main shall be in accordance with Section 02510a WATER DISTRIBUTION SYSTEM.

3.2.3 Operation Test

At conclusion of pressure test, sprinkler heads or emitter heads, quick coupling assemblies, and hose valves shall be installed and entire system tested for operation under normal operating pressure. Operation test consists of the system operating through at least one complete programmed cycle for all areas to be sprinkled.

3.3 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system. After as-built drawings are approved by Contracting Officer, controller charts and programming schedule shall be prepared. One chart for each controller shall be supplied. Chart shall be a reduced drawing of actual as-built system that will fit the maximum dimensions inside controller housing. Black line print for chart and a different pastel or transparent color shall indicate each station area of coverage. After chart is completed and approved for final acceptance, chart shall be sealed between two 0.505 mm (20 mil) pieces of clear plastic.

3.4 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

3.5 CLEANUP

Upon completion of installation of system, all debris and surplus materials resulting from the work shall be removed.

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SECTION 02821A

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SECTION 02821A

FENCING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 121	(1999) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(2001) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM F 1043	(2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM F 626	(1996a) Fence Fittings
ASTM F 668	(1999a) Poly(Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric

ASTM F 900

(1994) Industrial and Commercial Swing
Gates

MILITARY HANDBOOK

MIL-HDBK-1013

Dated 14 May 93

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

1.3 APPROVAL OF POLYVINYL CHLORIDE-COATED FENCE MATERIALS

Polyvinyl chloride-coated fence materials shall be thoroughly inspected for cracking, peeling, and conformance with the specifications by the Contracting Officer's Representative prior to installation. Any fence materials rejected by the Contracting Officer's Representative shall be replaced by the contractor with approved materials at no additional cost to the Government.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 610 grams of zinc per square meter of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire or Class 2b polyvinyl chloride-coated steel fabric with 92 grams of zinc coating per square meter in accordance with ASTM F 668. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh. Polyvinyl chloride coating for fabric and all other fence components shall be manufacturer's standard. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage (unless otherwise indicated).

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate frames shall be polyvinyl chloride-coated steel pipe (Group IA)(Group IC) with external coating Type A, a nominal pipe size (NPS) 1-1/2, conforming to ASTM F 1043.

Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Post shall be either Group IA steel pipe, Group IC, Group II, roll-formed steel sections, or Group III steel H-sections and shall be zinc coated (Type A) and polyvinyl chloride coated conforming to the requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 BRACES

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Braces and rails shall be Group IA, Group IC, steel pipe, size NPS 1-1/4 or Group II, formed steel sections, size 42 mm (1-21/32 inch) and shall be zinc coated (Type A) and polyvinyl chloride-coated conforming to the requirements of ASTM F 1043. Group II, formed steel sections, size 42 mm (1-21/32 inch), conforming to ASTM F 1043, may be used as braces if Group II line posts are furnished.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 ACCESSORIES

Fence accessories shall be of the same material as the fence fabric (zinc, aluminum or polyvinyl chloride (PVC) coated). PVC coating shall have minimum thickness of 0.152mm & maximum thickness of 0.381mm. Color coating of PVC coated fittings shall match the color coating of the fabric. ASTM F 626. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 3 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified. Threaded hardware shall be painted to match polyvinyl chloride coatings.

2.7 CONCRETE

ASTM C 94/C 94M, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.8 PADLOCKS

Padlocks shall conform to NSN 5340-00-158-3805 without chain or NSN 5340-00-158-3807, with change, Size 44 mm (1-3/4 inch).

2.9 GATE OPERATOR

Electric gate operators for sliding gates shall be as follows: Electrical gate operators shall have a right angle gearhead instantly reversing motor with magnetic drum-type brake, friction disc clutch, reversing starter with thermal overload protection, and a chain-driven geared rotary-type automatic limit switch. Gears shall consist of a hardened steel machine cut worm and mating bronze gear. All gears and bearings shall operate in a bath of oil. Gate operators with V-belt pulleys will not be allowed. Gate operators shall be equipped with an emergency release to allow the gate to be operated manually. The emergency release mechanism shall be capable of being locked in the engaged or disengaged position. Positive stops shall be provided on the gate tracks as a backup to the limit switches.

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3 m (10 feet) . Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m (500 feet) . Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 25 mm clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm (18 inches) in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm (18 inches) in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25 mm (1 inch) greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm (3 feet) and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 222.4 newtons (50 pound) force on the post, perpendicular to the fabric, at 1.52 m (5 feet) above ground; post movement measured at the point where the force is applied shall be less than or equal to 19 mm (3/4 inch) from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal

(compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m (6 feet) in height. A center brace or 2 diagonal truss rods shall be installed on 3.66 m (12 foot) fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m (6 feet) high or less if a top rail is installed.

3.5 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 102 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm (6 inches) of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.6 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm (15 inch) intervals.

The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm (15 inch) intervals and fastened to all rails and tension wires at approximately 610 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 222 newtons (50 pound) push-pull force at the center of the fabric between posts; the use of a 133 newtons (30 pound) pull at the center of the panel shall cause fabric deflection of not more than 63.5 mm (2-1/2 inches) when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.7 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

3.7.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored with 9.5 mm (3/8 inch) diameter plain pin rivets. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

3.8 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts

with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.9 GROUNDING

Fences crossed by overhead powerlines in excess of 600 volts shall be grounded as specified in Section 13100A LIGHTNING PROTECTION SYSTEM. Electrical equipment attached to the fence shall be grounded as specified in Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 15 m of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 198 m . Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 45 m on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 19 mm (3/4 inch) by 3.05 m (10 foot) long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 152 mm (6 inches) below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 305 mm deep and radially from the fence. The top of the electrode shall be not less than 610 mm or more than 2.4 m from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

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SECTION 02921A

SEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1995) Federal Seed Act Regulations Part 201
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
 Surface Erosion Control Material
 Chemical Treatment Material

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

Delivery

Delivery schedule.

Finished Grade and Topsoil

Finished grade status.

Topsoil

Availability of topsoil from the stripping and stock piling operation.

Quantity Check

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil

Samples taken from several locations at the source.

Soil Amendments

A 4.5 kg sample.

Mulch

A 4.5 kg sample.

SD-06 Test Reports

Equipment Calibration

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed
Topsoil
pH Adjuster
Fertilizer
Organic Material
Soil Conditioner
Mulch
Pesticide

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.
- h. Pesticide. EPA registration number and registered uses.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
LAWN SEED			
Cyndon dactylon	Common Bermuda	50 percent	90 percent
Eremochloa Ophiuroides	Centipede Grass	25 percent	90 percent
Lolium Multiflorum	Annual Rye Grass	25 percent	90 percent

2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be as follows:

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
Lolium Multiflorum	Annual Rye Grass	25 percent	100 percent

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300a EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.5.2 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 650 degrees C. Gradation: A minimum 90 percent shall pass a 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.3.5.3 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.5.4 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.5 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.6 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.7 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.7.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.7.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 19 to 25 mm square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 605 grams per meter and 1200 mm wide with mesh openings of approximately 25 mm square.

2.7.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.7.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal

life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.7.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed.

When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.1.2 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.1.3 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300a EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 25 mm depth and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 100 mm depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 50 mm depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 25 mm below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 16 mm in any dimension shall be removed from the surface.

3.2.4.3 Protection

Areas with the prepared surface shall be protected from compaction or

damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Hydroseeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.2 Hydroseeding

Seed shall be mixed to ensure broadcast at the rate of 50 kilograms per hectare . Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Wood cellulose fiber mulch and tackifier shall be added at the rates recommended by the manufacturer after the seed, fertilizer, and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.3 Mulching

3.3.3.1 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.3.4 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 25 mm depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Seeding

The application rate shall be 50 kilograms per square meter. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.6.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks,

clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.9 SEED ESTABLISHMENT PERIOD

3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of seeding work under this contract and shall continue through the remaining life of the contract and end 3 months after the last day of the seeding operation required by this contract. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be coordinated with Sections 02922a SODDING and 02930a EXTERIOR PLANTING. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm high.

3.9.2.1 Lawn Area

A satisfactory stand of grass plants from the seeding operation for a lawn area shall be a minimum 1000 grass plants per square meter. Bare spots shall be a maximum 150 mm square. The total bare spots shall be a maximum 2 percent of the total seeded area.

3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects

and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.9.3.1 Mowing

- a. Lawn Areas: Lawn areas shall be mowed to a minimum 75 mm height when the turf is a maximum 100 mm high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.
- b. Field Areas: Field areas shall be mowed once during the season to a minimum 75 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.9.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.3.4 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.5 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

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SECTION 02922A

SODDING

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a; R 2001) Agricultural Liming Materials
ASTM D 4972	(2001) pH of Soils
ASTM D 5268	(1992; R 1997) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Chemical Treatment Material

A listing of equipment to be used for the sodding operation. Manufacturer's literature including physical characteristics, application and installation instructions for equipment and chemical treatment material.

Delivery

Delivery schedule.

Finished Grade and Topsoil

Finished grade status.

Topsoil

Availability of topsoil from the stripping and stock piling operation.

Quantity Check

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed. The quantity of sod used shall be compared against the total area installed.

Sod Establishment Period

Calendar time period for the sod establishment period. When there is more than one sod establishment period, the boundaries of the sodded area covered for each period shall be described.

Maintenance Record

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil

Samples taken from several locations at the source.

Soil Amendments

A 4.5 kg sample.

Temporary Seeding

Sample of annual seed species and application rate.

SD-06 Test Reports

Equipment Calibration

Certification of calibration tests conducted on the equipment used in the sodding operation.

Soil Test

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Sod
 Topsoil
 pH Adjuster
 Fertilizer
 Organic Material
 Soil Conditioner
 Pesticide

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Sod. Classification, botanical name, common name, mixture percentage of species, percent purity, quality grade, field location and state certification.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Pesticide. EPA registration number and registered uses.

1.3 SOURCE INSPECTION

The sources of sod material and delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Sod

Sod shall be protected during delivery to prevent desiccation, internal heat buildup, or contamination.

1.4.1.2 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.3 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.4 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Sod shall be inspected upon arrival at the job site for conformity to species. Sod shall be checked for visible broadleaf weeds, and a visible consistency with no obvious patches of foreign grasses that exceed 2 percent of the canopy. Sod that is heating up, dry, moldy, yellow, irregularly shaped, torn, or of uneven thickness shall be rejected. Other materials shall be inspected for compliance with specified requirements. Open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter; and topsoil that contains viable plants and plant parts, shall be rejected. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Sod

Sod shall be stored in designated areas and kept in a moist condition by watering with a fine mist, and covered with moist burlap, straw, or other covering. Covering shall allow air to circulate, preventing internal heat from building up. Sod shall be protected from exposure to wind and direct sunlight until installed.

1.4.3.2 Other Material Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations, away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with sod operation materials.

1.4.4 Handling

Sod shall not be damaged during handling. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Time limitation between harvesting and installing sod shall be a maximum 36 hours.

PART 2 PRODUCTS

2.1 SOD

2.1.1 Sod Classification

Nursery-grown sod shall be provided as classified by applicable state laws. Sod section shall be sized to permit rolling and lifting without breaking.

2.1.2 Grass Species

Grass species shall be proportioned as follows:

Botanical Name	Common Name	Mixture Percent
Zoysia Matrella K Japonica	Zoysia '2-3'	100

2.1.3 Quality

Sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 25 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the sod section.

2.1.4 Thickness

Sod shall be machine cut to a minimum 35 mm thickness. Measurement for thickness shall exclude top growth and thatch.

2.1.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300a EARTHWORK. When additional topsoil is required beyond the available topsoil from stripping operation, topsoil

shall be delivered and amended as recommended by the soil test for the sod species specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash, or other material over a maximum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material, and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, fully composted or stabilized with nitrogen.

2.3.4.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent or less by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.3.4.5 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements for topsoil.

2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Greensand shall be balanced with the

inclusion of trace minerals and nutrients.

2.3.5.2 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to minimum temperature of 650 degrees C. Gradation: A minimum 90 percent passing 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.3.5.3 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.5.4 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 WATER

Water shall be the responsibility of the Contractor unless otherwise noted. Water shall not contain elements toxic to plant life.

2.5 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

PART 3 EXECUTION

3.1 INSTALLING SOD TIME AND CONDITIONS

3.1.1 Sodding Conditions

Sodding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the sodding operations, proposed alternate times shall be submitted for approval.

3.1.2 Equipment Calibration

Immediately prior to the commencement of sodding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. Provide calibration test results within one week of testing.

3.1.3 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the sod species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300a EARTHWORK.

3.2.1.1 Finished Grade for Airfields

Finished grades in sodded areas shall be undercut sufficiently so the top of newly laid sod will be 37.5 mm below adjacent paved areas and flush with any adjacent seeded or turfed areas except when directed otherwise by the Contracting Officer.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied at the rate recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 25 mm depth and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 100 mm deep. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 50 mm deep by scarifying with heavy rakes, or other method. Rototillers shall

be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 25 mm below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be rolled and completed with a light raking to remove from the surface debris and stones over a minimum 16 mm in any dimension.

3.2.4.2 Protection

Areas within the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing sod, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a maximum 25 mm depth.

3.3.1 Installing Sod

Rows of sod sections shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod sections shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. Sod sections shall be laid across the slope on long slopes. Sod sections shall be laid at right angles to the flow of water in ditches. Sod sections shall be anchored on slopes steeper than 3-horizontal-to-1-vertical. Anchoring may be required when surface weight or pressure upon placed sod sections is anticipated to cause lateral movement. Sod anchors shall be placed a minimum 600 mm on center with a minimum 2 anchors per sod section.

3.3.2 Finishing

Displacement of the sod shall be prevented by tamping or rolling the sod in place and knitting the sod to the soil. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed, and holes or missing corners shall be patched with sod.

3.3.3 Rolling

The entire area shall be firmed with a roller not exceeding 130 kilograms

per meter roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled.

3.3.4 Watering Sod

Watering shall be started immediately after completing each day of installing sod. Water shall be applied at least 3 times per week to supplement rainfall, at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm . Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.

3.4 TEMPORARY SEEDING

The application rate shall be 50 kilograms per square meter. When directed during contract delays affecting the sodding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded with annual seed in accordance with Section 02921a SEEDING. When there is no Section 02921a SEEDING provided in the project, an annual seed species and application rate shall be submitted for approval.

3.4.1 Soil Amendments, Tillage and Watering

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Sod as required.

3.4.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing sod.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of the material used shall be compared with the total area covered to determine the rate of application. The quantity of sod used shall be compared against the total area established with sod. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.6.1 Technical Representative

The certified installation pest management coordinator shall be the

technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the sodding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the sodded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the sodding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.9 SOD ESTABLISHMENT PERIOD

3.9.1 Commencement

The sod establishment period to obtain a healthy stand of grass plants shall commence on the first day of sodding work under this contract and shall continue through the remaining life of the contract and end 3 months after the last day of sodding operation required by this contract. Written calendar time period shall be furnished for the sod establishment period. When there is more than 1 sod establishment period, the boundaries of the sodded area covered for each period shall be described. The sod establishment period should be coordinated with Sections 02921a SEEDING and 02930a EXTERIOR PLANTING. The sod establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health. A satisfactory stand of grass plants from the sodding operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum 50 mm square. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

3.9.3 Maintenance During Establishment Period

Maintenance of the sodded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.9.3.1 Mowing

Sodded areas shall be mowed to a minimum 75 mm height when the turf is a maximum 100 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.9.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.3.4 Repair

Unsatisfactory stand of grass plants shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.5 Maintenance Record

A record of each site visit shall be furnished which describes the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

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SECTION 02930A
EXTERIOR PLANTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA Z60.1 (1996) Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5034 (1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)

ASTM D 5035 (1995) Breaking Force and Elongation of Textile Fabrics (Strip Method)

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

ASTM D 5883 (1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Scale drawings defining areas to receive plant materials.

Finished Grade, Topsoil and Underground Utilities

Finished grade status; location of underground utilities and facilities; and availability of topsoil from the stripping and stock piling operation.

SD-03 Product Data

Geotextile

Chemical Treatment Material

Manufacturer's literature including physical characteristics, application and installation instructions for geotextile and chemical treatment material.

Equipment

A listing of equipment to be used for the planting operation.

Delivery

Delivery schedule.

Plant Establishment Period

Calendar time period for the plant establishment period. When there is more than one establishment period, the boundaries of the planted areas covered for each period shall be described.

Maintenance Record

Maintenance work performed, quantity of plant losses, and replacements; and diagnosis of unhealthy plant material.

Application of Pesticide

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil

Samples taken from several locations at the source.

Soil Amendments

A 4.5 kg sample.

Mulch

A 4.5 kg sample.

Geotextile

A 150 mm square sample.

SD-06 Test Reports

Soil Test

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Plant Material

Topsoil

pH Adjuster

Fertilizer

Organic Material

Soil Conditioner

Organic Mulch

Pesticide

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

- a. Plant Material: Classification, botanical name, common name, size, quantity by species, and location where grown.
- b. Topsoil: Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster: Sieve analysis and calcium carbonate equivalent.
- d. Fertilizer: Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.

g. Organic Mulch: Composition, source, and treatment against fungi growth.

h. Pesticide. EPA registration number and registered uses.

SD-10 Operation and Maintenance Data

Maintenance Instructions

Instruction for year-round care of installed plant material.

1.3 SOURCE INSPECTIONS

The nursery or source of plant material and the source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Plant Material Identification

Plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical plant name and size.

1.4.1.2 Protection During Delivery

Plant material shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport.

1.4.1.3 Delivered Topsoil

Prior to the delivery of any topsoil, the availability of topsoil shall be verified in paragraph TOPSOIL. A soil test shall be provided for delivered topsoil.

1.4.1.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.5 Pesticide Material

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection

Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Inspection

Plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. Plant material showing desiccation, abrasion, sun-scald injury, disfigurement, or unauthorized substitution shall be rejected. The plant material shall exhibit typical form of branch to height ratio; and meet the caliper and height measurements specified. Plant material that measures less than specified, or has been poled, topped off or headed back, shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container. Plant material with broken or cracked balls; or broken containers shall be rejected. Bare-root plant material that is not dormant or is showing roots were pulled from the ground shall be rejected. Other materials shall be inspected for compliance with paragraph PRODUCTS. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 40 mm diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Plant Material Storage

Plant material not installed on the day of arrival at the site shall be stored and protected in designated areas. Plant material shall not be stored longer than 30 days. Plant material shall be protected from direct exposure to wind and sun. Bare-root plant material shall be heeled-in. All plant material shall be kept in a moist condition by watering with a fine mist spray until installed.

1.4.3.2 Other Material Storage

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with planting operation material.

1.4.4 Handling

Plant material shall not be injured in handling. Cracking or breaking the earth ball of balled and burlapped plant material shall be avoided. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles.

1.4.5 Time Limitation

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum 90 days. The time

limitation between installing the plant material and placing the mulch shall be a maximum 24 hours.

1.5 WARRANTY

Furnished plant material shall have a warranty for plant growth to be in a vigorous growing condition for a minimum 12 month period. A minimum 12 month calendar time period for the warranty of plant growth shall be provided regardless of the contract time period. When plant material is determined to be unhealthy in accordance with paragraph PLANT ESTABLISHMENT PERIOD, it shall be replaced once under this warranty.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

2.1.1 Plant Material Classification

The plant material shall be nursery grown stock conforming to ANLA Z60.1 and shall be the species specified.

2.1.2 Plant Schedule

The plant schedule shall provide botanical names as included in one or more of the publications listed under "Nomenclature" in ANLA Z60.1.

2.1.3 Substitutions

Substitutions will not be permitted without written request and approval from the Contracting Officer.

2.1.4 Quality

Well shaped, well grown, vigorous plant material having healthy and well branched root systems in accordance with ANLA Z60.1 shall be provided. Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging and preparation for shipment, method of shipment, or shipment. Plant quality is determined by the growing conditions; method of shipment to maintain health of the root system; and growth of the trunk and crown as follows.

2.1.5 Growing Conditions

Plant material shall be native to or well-suited to the growing conditions of the project site. Plant material shall be grown under climatic conditions similar to those at the project site.

2.1.6 Method of Shipment to Maintain Health of Root System

2.1.6.1 Container-Grown (C) Plant Material

Container size shall be in accordance with ANLA Z60.1. Plant material

shall be grown in a container over a duration of time for new fibrous roots to have developed and for the root mass to retain its shape and hold together when removed from the container. The container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

2.1.7 Growth of Trunk and Crown

2.1.7.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.
- c. Specimen: The tree provided shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.7.2 Palms

Palms shall have the specified height as measured from the base of the trunk to the base of the fronds or foliage in accordance with ANLA Z60.1. The palm shall have straight trunk and healthy fronds or foliage as typical for the variety grown in the region of the project. Palms trimmed or pruned for delivery shall retain a minimum of 150 mm of foliage at the crown as a means of determining plant health.

2.1.7.3 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANLA Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.7.4 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANLA Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.1.8 Plant Material Size

Plant material shall be furnished in sizes indicated. Plant material larger in size than specified may be provided at no additional cost to the

Government.

2.1.9 Plant Material Measurement

Plant material measurements shall be in accordance with ANLA Z60.1.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300a EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the plant material specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite is not recommended.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.25 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.25 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.25 mm sieve.

2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade; free flowing, pellet or tablet form;

uniform in composition; and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU).

Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Organic Material

Organic material shall consist of either bonemeal, peat, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.3.1 Bonemeal

Bonemeal shall be a finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.3.2 Rotted Manure

Rotted manure shall be unleached horse, chicken, or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and shall be free of stones, sticks, and soil.

2.3.3.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material free of stones, sticks, and toxic substances harmful to plants, and stabilized with nitrogen.

2.3.3.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from food, agricultural, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent or less by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.3.3.5 Worm Castings

Worm castings shall be screened from worms and food source and shall be commercially packaged.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or

gypsum for single use or in combination to meet topsoil requirements for the plant material specified.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Calcined Clay

Granular particles shall be produced from montmorillonite clay calcined to minimum temperature of 650 degrees C. Gradation: A minimum 90 percent passing 2.36 mm sieve; a minimum 99 percent shall be retained on 0.25 mm sieve; and a maximum 2 percent shall pass a 0.15 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.3.4.3 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.4.4 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure is not recommended to be used as a mulch because it would encourage surface rooting of the plant material and weeds.

2.4.1 Inorganic Mulch

When inorganic mulch is required for decorative purposes, it shall be provided in areas designated, and consist of:

crusher run rock ranging in size from 25 to 100 mm

2.4.2 Organic Mulch

Organic mulch materials shall be native to the project site and consist of recycled mulch, shredded bark, wood chips, or ground bark.

2.4.2.1 Recycled Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 65 x 65 mm screen. It shall be cleaned of all sticks a minimum 25 mm in diameter and plastic materials a minimum 75 mm length. The material shall be treated to retard the growth of mold and fungi. Other recycled mulch may include peanut shells, pecan shells or coco bean shells.

2.4.2.2 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.4.2.3 Wood Chips and Ground Bark

Locally chipped or ground material shall be treated to retard the growth of mold and fungi. Gradation: A maximum 50 mm wide by 100 mm long.

2.5 GEOTEXTILE

Geotextile shall be woven or nonwoven; polypropylene, polyester, or fiberglass, mat in accordance with ASTM D 5034 or ASTM D 5035. It shall be made specifically for use as a fabric around plant material. Nominal weight shall be a minimum 120 grams per square meter. Permeability rate shall be a minimum 1 mm per second.

2.6 WOOD STAKING MATERIAL

Wood stakes shall be hardwood or fir; rough sawn; free from knots, rot, cross grain, or other defects that would impair their strength.

2.6.1 Bracing Stake

Wood bracing stakes shall be a minimum 50 x 50 mm square and a minimum 2400 mm long with a point at one end. Stake shall be set without damaging rootball.

2.6.2 Wood Ground Stakes

Wood ground stakes shall be a minimum of 50 x 50 mm square and a minimum 900 mm long with a point at one end.

2.6.3 Deadmen

Wood deadmen shall be a minimum 100 x 100 x 900 mm long.

2.7 METAL STAKING AND GUYING MATERIAL

Metal shall be aluminum or steel consisting of recycled content made for holding plant material in place.

2.7.1 Bracing Stakes

Metal bracing stakes shall be a minimum 25 mm diameter and a minimum 2400 mm long. Stake shall be set without damaging rootball.

2.7.2 Metal Ground Stakes

Metal ground stakes shall be a minimum 13 mm diameter and a minimum 900 mm long.

2.7.3 Earth Anchor

Metal earth anchors shall be a minimum 13 mm diameter and a minimum 600 mm long.

2.7.4 Guying Material

Metal guying material shall be a minimum 12 gauge wire. Multi-strand cable shall be woven wire. Guying material tensile strength shall conform to the size of tree to be held firmly in place.

2.7.5 Turnbuckle

Metal turnbuckles shall be galvanized or cadmium-plated steel, and shall be a minimum 75 mm long with closed screw eyes on each end. Screw thread tensile strength shall conform to the size of tree to be held firmly in place.

2.8 PLASTIC STAKING AND GUYING MATERIAL

Plastic shall consist of recycled plastic product made for holding plant material firmly in place. Plastic shall not be used for deadmen.

2.8.1 Plastic Bracing Stake

Plastic bracing stakes shall be a minimum 50 mm diameter and a minimum 2400 mm long. Stake shall be set without damaging rootball.

2.8.2 Plastic Ground Stakes

Plastic ground stakes shall be a minimum 50 mm diameter and a minimum 900 mm long.

2.8.3 Plastic Guying Material

Plastic guying material shall be designed specifically for the purpose of firmly holding plant material in high wind velocities.

2.8.4 Chafing Guard

Plastic chafing guards shall be used to protect tree trunks and branches when metal is used as guying material. The material shall be the same color throughout the project site. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

2.9 RUBBER GUYING MATERIAL

Rubber chafing guards, consisting of recycled material, shall be used to protect tree trunks and branches when metal guying material is applied. The material shall be the same color throughout the project. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

2.10 FLAG

Plastic flag material shall be used on guying material. It shall be a minimum 150 mm long. Tape color shall be consistent and visually complimentary to the entire project area. The tape color shall meet pedestrian visual safety requirements for day and night.

2.11 TREE ROOT BARRIERS

Tree root barriers shall be metal or plastic consisting of recycled content. Barriers shall utilize vertical stabilizing members to encourage downward tree root growth. Barriers shall limit, by a minimum 90 percent, the occurrence of surface roots. Tree root barriers which are designed to be used as plant pit liners will be rejected.

2.12 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall not contain elements toxic to plant life.

2.13 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

PART 3 EXECUTION

3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS

3.1.1 Plant Material Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted for approval.

3.1.2 Tests

3.1.2.1 Percolation Test

Test for percolation shall be done to determine positive drainage of plant pits and beds. A positive percolation shall consist of a minimum 25 mm per 3 hours; when a negative percolation test occurs, a shop drawing shall be submitted indicating the corrective measures.

3.1.2.2 Soil Test

Delivered topsoil, excavated plant pit soil, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection onsite shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The

soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the plant material specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade, Topsoil and Underground Utilities

The Contractor shall verify that finished grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 02300a EARTHWORK, prior to the commencement of the planting operation. The location of underground utilities and facilities in the area of the planting operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2.2 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted to meet field conditions.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the planting area, the turf shall be covered and/or protected during planting operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline to protect them during planting operations.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to plant material location, type of plant and planting method shall be submitted for approval.

3.3.2 Turf Removal

Where the planting operation occurs in an existing lawn area, the turf shall be removed from the excavation area to a depth that will ensure the removal of the entire root system.

3.3.3 Plant Pits

Plant pits for ball and burlapped or container plant material shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits for bare-root plant material shall be dug to a depth equal to the height of the root system. Plant pits shall be dug a minimum 50 percent wider than the ball or root system to allow for root expansion. The pit shall be constructed with sides sloping towards the base as a cone, to encourage well aerated soil to be available to the root system for favorable root growth. Cylindrical

pits with vertical sides shall not be used.

3.4 INSTALLATION

3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown.

3.4.2 Tree Root Barrier

Tree root barriers shall be installed as recommended by the manufacturer. Tree root barriers shall be used for trees located up to a maximum 1800 mm from paved surfaces or structures.

3.4.3 Backfill Soil Mixture

The backfill soil mixture may be a mix of topsoil and soil amendments suitable for the plant material specified. When practical, the excavated soil from the plant pit that is not amended provides the best backfill and shall be used.

3.4.4 Backfill Procedure

Prior to backfilling, all metal, wood, synthetic products, or treated burlap devices shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Additional requirements are as follows.

3.4.4.1 Container-Grown and Balled and Potted Plant Material

The plant material shall be carefully removed from containers that are not biodegradable. Prior to setting the plant in the pit, a maximum 1/4 depth of the root mass, measured from the bottom, shall be spread apart to promote new root growth. For plant material in biodegradable containers the container shall be split prior to setting the plant with container. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped.

3.4.4.2 Earth Berm

An earth berm, consisting of backfill soil mixture, shall be formed with a minimum 100 mm height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

3.4.5 Plant Bed

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas. Earth berms shall be provided. Polymers shall be spread uniformly over the plant bed and in the planting

pit as recommended by the manufacturer and thoroughly incorporated into the soil to a maximum 100 mm depth.

3.4.6 Watering

Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

3.4.7 Staking and Guying

Staking will be required when trees are unstable or will not remain set due to their size, shape, or exposure to high wind velocity.

3.4.8 Flags

A flag shall be securely fastened to each guy line equidistant between the tree and the stake, deadmen, or earth anchor. The flag shall be visible to pedestrians.

3.5 FINISHING

3.5.1 Plant Material

Prior to placing mulch, the installed area shall be uniformly edged to provide a clear division line between the planted area and the adjacent turf area, shaped as indicated. The installed area shall be raked and smoothed while maintaining the earth berms.

3.5.2 Placing Geotextile

Prior to placing mulch, geotextile shall be placed as indicated in accordance with the manufacturer's recommendations.

3.5.3 Placing Mulch

The placement of mulch shall occur a maximum 48 hours after planting. Mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, shall be spread to cover the installed area with a minimum 100 mm uniform thickness. Mulch shall be kept out of the crowns of shrubs, ground cover, and vines and shall be kept off buildings, sidewalks and other facilities.

3.5.4 Pruning

Pruning shall be accomplished by trained and experienced personnel. The pruning of trees and palms shall be in accordance with ANSI A300. Only dead or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes maintaining the mulch, watering, and adjusting settling.

3.7 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.7.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.7.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.8 RESTORATION AND CLEAN UP

3.8.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.8.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

3.9 PLANT ESTABLISHMENT PERIOD

3.9.1 Commencement

The plant establishment period for maintaining exterior plantings in a healthy growing condition shall commence on the first day of exterior

planting work under this contract and shall continue through the remaining life of the contract and end 3 months after the last day of exterior planting required by this contract. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described. The plant establishment period shall be coordinated with Sections 02921a SEEDING, 02922a SODDING. The plant establishment period shall be modified for inclement weather shut down periods, or for separate completion dates for areas.

3.9.2 Maintenance During Establishment Period

Maintenance of plant material shall include straightening plant material, straightening stakes; tightening guying material; correcting girdling; supplementing mulch; pruning dead or broken branch tips; maintaining plant material labels; watering; eradicating weeds, insects and disease; post-fertilization; and removing and replacing unhealthy plants.

3.9.2.1 Watering Plant Material

The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of 25 mm absorbed water per week, delivered in the form of rain or augmented by watering. Run-off, puddling and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or existing plant material shall be prevented.

3.9.2.2 Weeding

Grass and weeds in the installed areas shall not be allowed to reach a maximum 75 mm height before being completely removed, including the root system.

3.9.2.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.2.4 Post-Fertilization

The plant material shall be topdressed at least once during the period of establishment with controlled release fertilizer, reference paragraph SOIL AMENDMENTS. Apply at the rate of 1 kilogram per 10 square meters of plant pit or bed area. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.9.2.5 Plant Pit Settling

When settling occurs to the backfill soil mixture, additional backfill soil shall be added to the plant pit or plant bed until the backfill level is equal to the surrounding grade. Serious settling that affects the setting of the plant in relation to the maximum depth at which it was grown

requires replanting in accordance with paragraph INSTALLATION. The earth berm shall be maintained.

3.9.2.6 Maintenance Record

A record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

3.9.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement.

Unhealthy or dead plant material shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.9.4 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION, and recommendations in paragraph PLANT ESTABLISHMENT PERIOD. Plant material shall be replaced in accordance with paragraph WARRANTY. An extended plant establishment period shall not be required for replacement plant material.

3.9.5 Maintenance Instructions

Written instructions shall be furnished containing drawings and other necessary information for year-round care of the installed plant material; including, when and where maintenance should occur, and the procedures for plant material replacement,.

-- End of Section --

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SECTION 02935A

EXTERIOR PLANT MATERIAL MAINTENANCE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5883 (1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Chemical Treatment Material

Manufacturer's literature including physical characteristics, application and installation instructions for chemical treatment material.

Work Plan and Schedule

Delivery Schedule

Contractor's work plan and schedules.

Maintenance Record

Contractor's record of each site visit.

Application of Pesticide

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-06 Test Reports

Soil Tests Percolation Test

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

pH Adjuster Fertilizer Mulch Pesticide

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- b. Fertilizer. Chemical analysis and composition percent.
- c. Mulch: Composition and source.
- d. Pesticide. EPA registration number and registered uses.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery Schedule

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.3.2 Delivery of Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.3.3 Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.3.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.1.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified or in place.

2.1.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.1.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.1.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.1.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.1.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.1.4 Organic Material

Organic material shall consist of bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.1.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.1.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds.

2.1.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall consist of ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.1.4.4 Recycled Compost

Recycled compost shall be well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.1.4.5 Worm Castings

Worm castings shall be screened from worms and food source, commercially packaged.

2.1.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination.

2.1.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Green sand shall be balanced with the inclusion of trace minerals and nutrients.

2.1.5.2 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 650 degrees C. Gradation: A minimum 90 percent shall pass a 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.1.5.3 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.1.5.4 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall conform to ASTM D 5883.

2.2 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure shall not be used.

2.2.1 Inorganic Mulch

Where inorganic mulch is used for decorative purposes, it shall be replaced or augmented in areas designated. Match existing mulch in size, color, and texture.

Crusher run rock ranging in size from 25 to 100 mm.

2.2.2 Organic Mulch

Organic mulch materials shall be native to the project site and consist of recycled mulch, shredded bark, wood chips, or ground bark for use when remulching trees, shrubs, and ground covers.

2.2.2.1 Recycled Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 65 x 65 mm screen. It shall be cleaned of all sticks a minimum 25 mm in diameter and plastic materials a minimum 75 mm length. The material shall be treated to retard the growth of mold and fungi. Other recycled mulch may include peanut shells, pecan shells or coco bean shells.

2.2.2.2 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.2.2.3 Wood Chips and Ground Bark

Locally chipped or ground material shall be treated to retard the growth of mold and fungi. Gradation: A maximum 50 mm wide by 100 mm long.

2.3 WATER

Water will be furnished by the Government. Water shall not contain elements toxic to plant life.

2.4 PESTICIDE

Pesticide shall be an insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.5 HERBICIDE

Herbicide shall be EPA registered and approved; furnished for preemergence and postemergence application for crabgrass control and broad leaf weed control and complying with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification, and record keeping. Contractor shall keep records of all pesticide applications and forward data monthly to Contracting Officer. Record keeping format shall be submitted to Contracting Officer for approval.

PART 3 EXECUTION

3.1 SOIL TESTS

Contractor shall perform soil tests in accordance with ASTM D 4972.

3.2 SITE PREPARATION

3.2.1 Applying pH Adjuster

The pH adjuster shall be applied at the rate recommended by the soil test.

Soil conditioner shall be applied at a rate recommended by the soil test.

3.2.2 Applying Fertilizer

The fertilizer shall be applied at the rate recommended by the soil test.

3.3 MULCHING

Mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.4 WATERING

Water to supplement rainfall shall be applied at a rate sufficient to ensure plant growth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.5.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control.

3.5.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended to prevent the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.6 GENERAL MAINTENANCE REQUIREMENTS

3.6.1 Fertilization

Fertilizer shall be applied at rate recommended by the soil test. Application shall be performed without burning plants.

3.6.2 Pesticide Treatment

Pesticide treatment for disease or pest shall be in accordance with

paragraph APPLICATION OF PESTICIDE.

3.6.3 Irrigation Maintenance

The Contractor shall service and repair controller, pumps, valves, couplers, sprinklers, sprinkler heads, piping; and shall be responsible for winterization and startup. Sprinkler heads shall direct water away from building. The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone; the amount of water required shall be the equivalent of 25 mm absorbed water per week. Amount of irrigation watering shall take amounts of rain into account.

3.6.4 Maintenance Record

A record of each site visit shall be furnished, describing:

- a. Maintenance work performed.
- b. Areas repaired or reinstalled.
- c. Diagnosis for unsatisfactory stand of grass.
- d. Diagnosis for unsatisfactory stand of plant material in planting bed.
- e. Condition of trees.
- f. Condition of shrubs.
- g. Quantity and diagnosis of plant loss.
- h. Irrigation of system.

3.7 GRASS PLANT QUALITY

Grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm high. The living grass area shall be maintained to be uniform in color and leaf texture; and free from weeds and other undesirable growth. The living grass area shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 25 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the total area.

3.7.1 Lawn Area

A satisfactory stand of grass plants for a lawn area shall be a minimum 200 grass plants per square meter. Bare spots shall be a maximum 150 mm square. The total bare spots shall be a maximum 2 percent of the total area.

3.8 LAWN AREA MAINTENANCE

3.8.1 Mowing

Lawn areas shall be mowed throughout the growing season to meet the requirements of paragraph GRASS PLANT QUALITY. Cutting height shall be adjusted according to type of grass. Frequency of mowing shall be adjusted so that no more than 1/4 of leaf length is removed during a cutting.

3.8.1.1 Lawn Areas

Lawn areas shall be mowed to a minimum 13 mm height when the turf is a maximum 50 mm high. Remove clippings when the amount cut prevents sunlight from reaching the ground surface.

3.8.2 Turf Trimming

Turf adjoining paved areas, planting beds and trees shall be kept neatly trimmed at all times, essentially after each mowing. String trimmers at trees and shrubs will be allowed.

3.8.3 Aeration

Turf areas shall be aerated once per year using approved devices. Coring shall be performed by pulling soil plugs to minimum of 100 mm. Soil plugs produced in turf areas shall be left in place. Debris generated during aeration operations shall be removed.

3.8.4 Lime

Lime for pH modification shall be applied as required to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.5 Herbicide Weed Control

Two or more applications of a pre-emergent herbicide and of a post-emergent herbicide shall be performed to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.6 Turf Fertilization Program

A regular program of fertilization shall be established to include a spring feeding and early summer feeding to meet the requirements of paragraph GRASS PLANT QUALITY. A total of four pounds of Nitrogen per 92 square meters shall be applied annually. Additional one pound Nitrogen applications shall be provided as grass color warrants.

3.9 PLANTING BEDS MAINTENANCE

3.9.1 Trimming

Spent flower heads shall be removed. Seasonal succession of bloom requires removal for new plant or trimming back bulb foliage.

3.9.2 Irrigation of Planting Beds

Run-off, puddling and wilting, watering of other adjacent areas or existing plant material shall be prevented.

3.9.3 Weed Control

Grass and weeds in planting beds shall be completely removed before reaching 75 mm in height.

3.10 PLANT MATERIAL QUALITY

3.10.1 General Requirements

Plant material shall be identified as native to the region of the site or as a specimen. Plant material shall be maintained as well shaped, well grown, vigorous plant material having healthy root systems. The plant material shall be maintained as free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems. Plant quality is determined by the growing conditions; climate and microclimate of the site for maintaining a healthy root system; and growth of the trunk and crown as follows.

3.10.2 Growth of Trunk and Crown

3.10.2.1 Deciduous Trees

Deciduous tree height to caliper relationship shall be maintained. Height of branching shall bear a relationship to the size and species of the tree and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.
- c. Specimen: The tree shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be indicated.

3.10.2.2 Palms

Palms shall be maintained to have healthy fronds or foliage as typical for the variety grown in the region of the site.

3.10.2.3 Deciduous Shrubs

Deciduous shrub height to number of primary stems shall be maintained. Shrubs shall be maintained as well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the site.

3.10.2.4 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall be maintained to have a heavy, well developed, and balanced crown with vigorous, well developed root system.

3.11 SHRUB AND HEDGE MAINTENANCE

3.11.1 Trimming and Pruning

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height, and shape).
- c. Health (removing broken, diseased branches).
- d. Rejuvenation (removing one third to one half of the older stems or branches).
- e. Visibility (signs, building entrances, motorist line of sight).

Shrubs shall be pruned to the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material or the theme shape of the hedge shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed.

3.11.2 Irrigation of Shrubs and Hedges

Run-off, puddling and wilting shall be prevented.

3.11.3 Shrub Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12 TREE MAINTENANCE

3.12.1 Trimming and Pruning of Trees

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height).
- c. Health (removing broken, diseased wood branches).
- d. Rejuvenation (removing one third to one half of the older stems or

branches).

- e. Visibility (signs, building entrances, motorist line of sight).

Trees shall be pruned to meet the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.12.2 Irrigation of Trees

Run-off, puddling and wilting shall be prevented.

3.12.3 Tree Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12.4 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement. Unhealthy or dead plant material shall be removed immediately.

3.13 RESTORATION AND CLEAN UP

3.13.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the maintenance operations shall be restored to original condition at Contractor's expense.

3.13.2 Clean Up

Excess and waste material shall be removed from the maintenance areas and dispose off site. Adjacent paved areas shall be cleaned as determined by the Contracting Officer.

3.14 CLEANING OF PAVED AREAS

Grass, weeds, leaves, and debris from mowing, clipping, and pruning shall be removed immediately. Excess and waste material shall be removed from paved areas and disposed off site.

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SECTION 03100A

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SECTION 03100A

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

U.S. DEPARTMENT OF COMMERCE (DOC)

PS-1 (1996) Voluntary Product Standard -
Construction and Industrial Plywood

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Formwork

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

SD-03 Product Data

Design

Design analysis and calculations for form design and methodology used in the design.

Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents

Manufacturer's recommendation on method and rate of application of form releasing agents.

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class A Finish

Forms for Class A finished surfaces shall be plywood panels conforming to PS-1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS-1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

2.1.5 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

2.2 FIBER VOID RETAINERS

2.2.1 Precast Concrete

Precast concrete units shall have a compressive strength of not less than 17 MPa , reinforced with 150 mm by 150 mm by W1.4 WWF wire mesh, and 300 mm (height) by 1 m (length) by 40 mm (thickness) in size unless indicated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A finish, joints in form panels shall be arranged as approved.

Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class A finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 3 m of length ----- 6 mm
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length -- 25 mm
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 6 m of length ----- 6 mm Maximum for entire length 13 mm
2. Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ----- 6 mm In any bay or in any 6 m of length ----- 10 mm
a. In slab soffits, ceilings beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length - 20 mm
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 6 m of length ----- 6 mm Maximum for entire length - 13 mm

TABLE 1

TOLERANCES FOR FORMED SURFACES

3.	Variation of the linear building lines from established position in plan	In any 6 m ----- 13 mm Maximum ----- 25 mm
4.	Variation of distance between walls, columns, partitions	6 mm per 3 m of distance, but not more than 13 mm in any one bay, and not more than 25 mm total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ----- 6 mm Plus ----- 13 mm
6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ----- 6 mm Plus ----- 13 mm
7.	Footings:	
	a. Variation of dimensions in plan	Minus ----- 13 mm Plus ----- 50 mm when formed or plus 75 mm when placed against unformed excavation
	b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 50 mm
	c. Reduction in thickness	Minus ----- 5 percent of specified thickness
8.	Variation in steps:	Riser ----- 3 mm
	a. In a flight of stairs	Tread ----- 6 mm
	b. In consecutive steps	Riser ----- 2 mm Tread ----- 3 mm

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SECTION 03150A

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-- End of Section Table of Contents --

SECTION 03150A

EXPANSION JOINTS AND CONTRACTION JOINTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 919 (1984; R 1998) Use of Sealants in Acoustical Applications

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM D 1190 (1997) Concrete Joint Sealer, Hot-Applied Elastic Type

ASTM D 1191 (1984; R 1994e1) Concrete Joint Sealers

ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 5249 (1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Preformed Expansion Joint Filler; GRE
Sealant; GRE

Manufacturer's literature, including safety data sheets, for preformed fillers; field-molded sealants and primers (when required by sealant manufacturer); and recommended instructions for installing preformed fillers, field-molded sealants.

SD-07 Certificates

Preformed Expansion Joint Filler; GRE
Sealant; GRE

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm (1/8 inch) thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 10 mm (3/8 inch) thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

2.3.2 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 3 mm wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 3 mm (1/8 inch) radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the

finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 4 degrees C. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed.

Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

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SECTION 03200A

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- 2.2 FABRICATED BAR MATS
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PART 3 EXECUTION

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SECTION 03200A

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM (1999) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 82 (1997a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 184/A 184M (1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 615/A 615M (1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 675/A 675M (1990a; R 1995e1) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM A 884/A 884M (1996ae1) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1

(1996) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M/318RM. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M/318RM at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through

construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M/318RM . If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M/318RM and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

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SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made from Jute or Kenaf
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory

Evaluation

ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

ASTM C 1315	(1995) Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 638	(1998) Standard Tet Method for Tensile Properties of Plastic
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM E 1709	(1995; Rev A) Standard Test Method for Measurement of Retroreflective Signs Using a Portable Retroreflective EL-1996)
ASTM E 1745	(1996) Water Vapor Retarders Used in Contact with the Earth Concrete Slabs
ASTM E 96	(2000) Water Vapor Transmission of Materials

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop
COE CRD-C 94	(1995) Surface Retarders

1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G.

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications; G

Written documentation for Contractor Quality Control personnel.

SD-08 Manufacturer's Instructions

Application

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each type of hardener/sealer. Detailed application instructions, minimum and maximum application temperature, curing and drying times of hardener/sealer.

1.4 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
 Concrete Laboratory Testing Technician, Grade I or II
 Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or
 Reinforced Concrete Special Inspector, Jointly certified by
 American Concrete Institute (ACI), Building Official and Code
 Administrators International (BOCA), International Conference of
 Building Officials (ICBO), and Southern Building Code Congress
 International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.5 TECHNICAL REPRESENTATIVE

Hardener/sealer manufacturer's Technical Representative shall be made available for initial training of applicators and field observation during installation of the hardener/sealer. Technical Representative shall certify installations for warranty.

1.6 GENERAL REQUIREMENTS

1.6.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.6.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
-----	-----
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.6.1.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Bullfloated 13 mm
 Straightedged 8 mm
 Float Finish 5 mm
 Trowel Finish 5 mm

1.6.2 Strength Requirements and w/c Ratio

1.6.2.1 Strength Requirements

Specified compressive strength ($f'c$) shall be as indicated:

Compressive strength shall be determined in accordance with ASTM C 39/C 39M.
 Flexural strength shall be determined in accordance with ASTM C 78.

- a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength $f'c$ and no individual test result falls below the specified strength $f'c$ by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
- b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and

curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure.

Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

- c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.
- d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	All

The maximum w/c required will be the equivalent w/c as determined by the weight ratio of water to cement.

1.6.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 3 and 5 percent total air. Concrete with specified strength over 35 MPa may have 1.0 percent less air than specified above. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.6.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	50 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added.

1.6.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C.

1.6.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.6.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious materials as specified, aggregates, water and admixtures as specified.

1.7.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.7.2 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'_{cr}) exceeding the specified compressive strength (f'_c) by the amount indicated below. This required average compressive strength, f'_{cr} , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'_{cr} during

concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'_{cr} , the mixture shall be adjusted, as approved, to bring the daily average back up to f'_{cr} . During production, the required f'_{cr} shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.7.2.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'_c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'_{cr} used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'_{cr} = f'_c + 1.34S \text{ where units are in MPa}$$

$$f'_{cr} = f'_c + 2.33S - 3.45 \text{ where units are in MPa}$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.7.2.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'_{cr} shall be determined as follows:

- a. If the specified compressive strength f'_c is less than 20 MPa,

$$f'_{cr} = f'_c + 6.9 \text{ MPa}$$

b. If the specified compressive strength $f'c$ is 20 to 35 MPa,

$$f'cr = f'c + 8.3 \text{ MPa}$$

c. If the specified compressive strength $f'c$ is over 35 MPa,

$$f'cr = f'c + 9.7 \text{ MPa}$$

1.7.3 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.8 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.9 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.9.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.9.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.9.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

1.10 WARRANTY

Hardener/sealer manufacturer's "Full System 10 year warranty" on the replacement of all flooring material and labor that delaminates due to moisture migration, excessive vapor emissions or contaminates, shall be provided on all concrete floors to receive carpet and/or resilient flooring.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I with a maximum 15 percent amount of tricalcium aluminate, or Type II.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 67, except for slab-on-grade, size and description shall be a combination blend of No. 57 and 67.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies. High range water reducers shall be used for slabs and toppings.

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound

meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade C, and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the 0.6 mm sieve to particles passing the 2.36 mm sieve.

2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.11 FLOOR HARDENER/SEALER

Floor hardener shall be a colorless aqueous solution containing zinc

silicofluoride or magnesium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

a. All concrete floors to receive carpet or resilient flooring shall be provided with a hardener/sealer having a minimum of 35% solids and shall comply with ASTM C 309 and ASTM C 1315.

b. All exposed concrete floors shall be provided with a hardener/sealer having a minimum of solids and shall comply with ASTM C 309.

2.12 VAPOR BARRIER

Vapor barrier material shall be STEGO WRAP and/or shall have the following properties:

Manufactured with ISO certified virgin resins.

Water Vapor Retarder	ASTM E 1745	exceeds Class B
Water Vapor Transmission Rate	ASTM E 96	not exceeding 0.0006 gr./ft ² /hr.
Permeance Rating	ASTM E 96	not exceeding 0.01 gr./ft ² /hr.
Puncture Resistance	ASTM E 1709	minimum 1970 grams
Tensile Strength	ASTM D 638	minimum 45.0 lbf/in.

Installation shall be in accordance with manufacturer's instructions including taping procedures, tape material used, patching procedures, and installation at vertical walls. No penetration of the vapor barrier, except required by installation of permanent utilities, shall be allowed. The vapor barrier shall not be left exposed to the ultraviolet rays for more than a day prior to the concrete slab pour. Standing water on the vapor barrier shall be air dried or removed by vacuum prior to pouring the concrete slab.

2.13 JOINT MATERIALS

2.13.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for and sealing of joints shall conform to the requirements of Section 07900a JOINT SEALING.

2.13.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from mud and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100a STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200a CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02315a EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete.

For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Vapor barrier shall be placed, as shown. Concrete placement shall be controlled so as to prevent damage to the vapor barrier.

3.1.4 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitator transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

3.3 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.3.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.3.2 Transfer Hoppers

Concrete may be charged into nonagitator hoppers for transfer to other

conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.3.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.3.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.3.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper, for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 900 mm. The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.3.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.4 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the

introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.4.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.4.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall

not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.4.3 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

3.4.4 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.4.5 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall

be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion.

3.5 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900a JOINT SEALING.

3.5.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located, as indicated. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm

square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.5.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations, use of snap-out plastic joint forming inserts, or sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.5.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150a EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900a JOINT SEALING.

3.5.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150a EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.5.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200a CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.6 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100a STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish

is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.6.1 Class A Finish

Class A finish is required for all areas except where Class C and D finish are specified. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100a STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. Metal tools shall not be used to finish repairs in Class A surfaces.

3.6.2 Class C and Class D Finish

Class C finish is required for concealed surfaces not exposed to view that are covered by Class D finish. Class D finish is required for wall and foundation surfaces where backfill will be placed. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100a STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

3.7 REPAIRS

3.7.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least

as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.7.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class A finishes, more than 12 mm in diameter and, for Class C and D finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.7.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as

approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.7.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.8 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.8.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the

elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.8.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.8.3 Floated Finish

All slabs for mechanical service yards and trash enclosures shall be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.8.4 Troweled Finish

All areas not specified otherwise, shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an

approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.8.5 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.8.5.1 Broomed

All exterior slabs except pattern walkways shall be given a broomed finish. Exterior slabs include sidewalks and walkways. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.8.5.2 Abrasive Aggregate

All stairways shall be given an abrasive aggregate finish. The concrete surface shall be given a float finish. Abrasive aggregate shall then immediately be uniformly sprinkled over the floated surface at a total rate of not less than 1.25 kg per square meter spread in two applications at right angles to each other. The surface shall then be troweled to a smooth, even finish that is uniform in texture and appearance and free from blemishes including trowels marks. Immediately after curing, cement paste and laitance covering the abrasive aggregate shall be removed by steel brushing, rubbing with abrasive stone, or sandblasting to expose the abrasive particles.

3.9 FLOOR HARDENER/SEALER

Areas as indicated on the drawings shall be treated with floor hardener/sealer. Floor hardener/sealer shall be applied after the concrete has hardened and shall be applied after the concrete has hardened and shall be applied in strict accordance with the manufacturer's recommendations and printed instructions. The floor hardener/sealer shall be applied at the rate of 18.58 sq. meters (200 SF) per gallon.

3.10 EXTERIOR SLAB AND RELATED ITEMS

3.10.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement.

The surface shall then be tested for trueness with a 3.75 straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge.

Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm. Curing shall be as specified.

3.10.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

3.10.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion joints (12 mm wide) shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.10.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.11 CURING AND PROTECTION

3.11.1 General

Concrete shall be cured by an approved method for the period of 7 days.

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.11.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that

moist curing is continuous 24 hours per day.

3.11.3 Membrane Forming Curing Compounds

Membrane forming curing compounds maybe used on all concrete surfaces except as specified herein. Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a hardner/sealer meeting ASTM C 309, and ASTM C 1315, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of carpet or resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 500 kPa, at a uniform coverage of not more than 10 cubic meters per L for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.11.4 Impervious Sheeting

Except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 450 mm wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 300 mm and securely weighted down or shall be lapped not less than 100 mm and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.11.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.12 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used where indicated.

3.12.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed.

The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.12.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.12.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.12.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a

smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.13 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and as required thereafter for conformance with ASTM C 1077.

3.13.1 Grading and Corrective Action

3.13.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.13.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.13.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.13.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.13.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

3.13.5 Concrete Mixture

- a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be

kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

- b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.
- c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be

averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

- d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.
- e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.
- f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test

specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.13.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.13.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.13.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.13.9 Curing Inspection

- a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.
- b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.
- c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square meters per Liter, and shall note whether or not coverage is uniform.
- d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.
- e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.
- f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.13.10 Mixer Uniformity

- a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.
- b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.
- c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or

adjustments shall be made to the mixer until compliance is achieved.

3.13.11 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

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SECTION 04200

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SECTION 04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 530.1	(1999) Specifications for Masonry Structures and Related Commentaries
ACI 318/318M	(2002) Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(2001) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(2001b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 90	(2002) Loadbearing Concrete Masonry Units
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 144	(1999) Aggregate for Masonry Mortar
ASTM C 150	(2002) Portland Cement
ASTM C 270	(2001a) Mortar for Unit Masonry
ASTM C 315	(2002) Clay Flue Linings
ASTM C 476	(2001) Grout for Masonry
ASTM C 780	(2000) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019	(2000b) Sampling and Testing Grout
ASTM C 1142	(1995; R 2001) Extended Life Mortar for Unit Masonry
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2240	(2002) Rubber Property - Durometer Hardness
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 447	(1997) Compressive Strength of Masonry Prisms

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Masonry Work; G, RE

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-04 Samples

Concrete Masonry Units (CMU); G

Anchors, Ties, and Bar Positioners

Two of each type used.

Expansion-Joint Materials; G

One piece of each type used.

Joint Reinforcement

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

SD-05 Design Data

Pre-mixed Mortar; G, RE

Unit Strength Method; G, RE

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Efflorescence Test; G

Field Testing of Mortar; G

Field Testing of Grout; G

Prism tests; G

Fire-rated CMU; G

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G

Copies of masonry inspector reports.

SD-07 Certificates

Concrete Masonry Units (CMU)

Control Joint Keys

Anchors, Ties, and Bar Positioners

Expansion-Joint Materials

Joint Reinforcement

Reinforcing Steel Bars and Rods

Admixtures for Masonry Mortar

Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 2.5 m long by 1.8 m high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 600 by 600 mm opening placed at least 600 mm above the panel base and 600 mm away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

The Contractor shall demonstrate and receive approval on the method that will be used to support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed

from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. Protect units from rain and ground water. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 STRUCTURAL MASONRY

1.5.1 Special Inspection (For Barracks BK-1 and BK-2 Only)

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.5.2 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530.1. Submit calculations and certifications of unit and mortar strength.

1.6 QUALITY ASSURANCE

1.6.1 Testing

Masonry strength shall be determined in accordance with ACI 530.1; submit test reports on three prisms in accordance with ASTM E 447, Method B modified as specified in ACI 530.1. The cost of testing shall be paid by the Contractor.

1.6.2 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

1.6.3 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

- a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.
- b. Mortar joint widths shall be maintained as specified.
- c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.
- d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.
- e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.
- f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.
- g. Additional metric guidance shall conform to Section 01415 METRIC MEASUREMENTS.

2.2 CONCRETE MASONRY UNITS (CMU)

Concrete masonry units shall conform to ASTM C 90, Type II normal weight, except oven-dry weight shall be no less than 119 pounds per cubic foot for hollow load bearing units. Cement shall have low alkali content and be of one brand. The color and texture of the concrete masonry units shall be specified by the Contracting Officer. The finished surfaces that will be exposed in place shall conform to an approved sample consisting of not less than four units, representing the range of texture and color permitted.

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond; exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

2.2.1 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.2.1.1 Patterned, Decorative Screen Units

Patterned, decorative screen units shall conform to the applicable requirements of ASTM C 90. Units shall have uniform through-the-wall pattern, color, and texture.

2.3 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 20 MPa minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm (1/2 inch) to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 20 mm shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa (120 psi) for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 35 kg shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise

specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.3.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. In reinforced masonry, lintels shall conform to ACI 318/318M for flexural and shear strength and shall have at least 200 mm bearing at each end. Concrete shall have a minimum 28 day compressive strength of 17 MPa using 12 mm nominal-size coarse aggregate. Reinforcement shall conform to ASTM A 615/A 615M Grade 400 MPa. Limit lintel deflection due to dead plus live load to L/600 or 7 mm. Provide top and bottom bars for lintels over 900 mm in length.

2.3.2 Sills and Copings

Sills and copings shall be cast with washes. Sills for windows having mullions shall be cast in sections with head joints at mullions and a 6 mm (1/4 inch) allowance for mortar joints. The ends of sills, except a 20 mm wide margin at exposed surfaces, shall be roughened for bond. Treads of door sills shall have rounded nosings. Reinforce sills with not less than two No. 15 bars.

2.3.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.3.4 Flue Linings and Thimbles

ASTM C 315, free from fractures. Sizes and shapes shall be as indicated.

2.4 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type I or II portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar. Masonry cement shall not be used.

2.5 MASONRY MORTAR

Mortar Type S shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and Type S for remaining masonry work. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a

low alkali content and be of one brand. Aggregates shall be from one source.

2.5.1 Cement

Portland cement shall conform to ASTM C 150, Type I or II. Masonry cement shall not be used. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.5.2 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RS.

2.5.3 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.6 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. Minimum grout strength shall be 14 MPa in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.6.1 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.7 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

2.7.1 Dovetail Anchors

Dovetail anchors shall be triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of concrete masonry units to concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7.2 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.8 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.9 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.10 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 2 mm (1/16 inch). The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.11 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900a JOINT SEALING.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 32 degrees C and the wind velocity is more than 13 km/h . All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.3 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.4 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm . Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm . Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. The vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent

mortar from dropping into the space below.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 50 by 75 mm . Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 12 mm . Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

3.2.4.1 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless

noted otherwise. Concrete masonry units shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines
and surfaces of columns, walls and arises

In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations from the plumb for external corners,
expansion joints, and other conspicuous lines

In 6 m	6 mm
In 12 m or more	13 mm

Variations from the level for exposed lintels,
sills, parapets, horizontal grooves, and other
conspicuous lines

In 6 m	6 mm
In 12 m or more	13 mm

Variation from level for bed joints and top
surfaces of bearing walls

In 3 m	6 mm
In 12 m or more	13 mm

Variations from horizontal lines

In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations in cross sectional dimensions of
columns and in thickness of walls

Minus	6 mm
Plus	13 mm

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm . On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm .

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints, except for prefaced concrete masonry units.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Tothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be rettempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.4 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm of tops of walls.

3.4.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in

position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.4.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.5 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 400 mm on center or as indicated. Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.6 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.6.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.6.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.6.3 Grout Holes and Cleanouts

3.6.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall

be plugged and finished to match surrounding surfaces.

3.6.4 Grouting Equipment

3.6.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.6.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.6.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state.

3.6.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2)
			Hollow-unit Masonry
0.3	Fine	Low Lift	40 x 50
1.5	Fine	Low Lift	50 x 75
0.3	Coarse	Low Lift	40 x 75
1.5	Coarse	Low Lift	65 x 75

Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
 - a) The required minimum dimensions of total clear areas given in the table above;
 - b) The width of any mortar projections within the space;
 - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm or greater in width.
- (3) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.8 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using mortar to fill the head joint. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses

on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 20 mm; backer rod and sealant shall be installed in accordance with Section 07900a JOINT SEALING. Exposed interior control joints shall be raked to a depth of 6 mm . Concealed control joints shall be flush cut.

3.9 LINTELS

3.9.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 13 mm above the bottom inside surface of the lintel unit.

3.9.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 200 mm unless otherwise indicated on the drawings.

3.10 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.11 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.11.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.12 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.13 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashes shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar,

until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.13.1 Concrete Masonry Unit Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.14 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.15 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.16 TEST REPORTS

3.16.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.16.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

3.16.3 Prism Tests

At least one prism test sample shall be made for each 465 square meters of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ASTM E 447. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall

not be less than 10.3 MPa at 28 days. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 3.5 MPa below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

3.17 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

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DIVISION 05 - METALS

SECTION 05120

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SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC Design Guide No. 10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC M013	(1983) Detailing for Steel Construction
AISC M016	(1989) ASD Manual of Steel Construction
AISC M017	(1992; Errata 1994) Connections
AISC S303	(1992) Steel Buildings and Bridges
AISC S329	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts
AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

ASME INTERNATIONAL (ASME)

ASME B46.1	(1995) Surface Texture, (Surface Roughness, Waviness, and Lay)
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36/A36M	(1997; Rev. A) Carbon Structural Steel
ASTM A53	(1999; Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A123/A123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	(1974; R 1994) Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153/A153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(1997) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A490M	(1993) Heat-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563M	(1997) Carbon and Alloy Steel Nuts (Metric)
ASTM A563	(1997) Carbon and Alloy Steel Nuts
ASTM A780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(1998e1) Steel for Structural Shapes for Use in Building Framing
ASTM C827	(1995; R 1997) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM C1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F436M	(1993) Hardened Steel Washers (Metric)
ASTM F844	(1998) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959M	(1999; Rev. A) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
STEEL STRUCTURES PAINTING COUNCIL (SSPC)	
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1991) Epoxy-Polyamide Painting System

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC M016 and AISC M017 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

In AISC M016, and AISC M017, except as modified in this section, shall be considered a part of AISC M016 and AISC M017 and is referred to in this section as AISC M016 and AISC M017.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection drawings, including description of temporary supports; G

Fabrication drawings, including description of connections; G

SD-03 Product Data

Shop primer

Load indicator washers

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

Galvanizing

AISC Quality Certification

Welding procedures and qualifications

1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Sbd fabrication plant.

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC M013, AISC M016 and AISC M017. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings.

1.6.2 Certifications

1.6.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.6.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A36/A36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A992/A992M Grade 50.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes shall conform to ASTM A992/A992M.

2.1.4 Structural Steel Tubing

Structural tubing shall conform to ASTM A500, Grade B.

2.1.5 Steel Pipe

ASTM A53, Type E or S, Grade B, weight class as indicated.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts

ASTM A307, Grade A and ASTM A325M, Type 1, as indicated. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563M, Grade A, heavy hex style, except nuts under M36 may be provided in hex style.

2.2.1.3 Washers

ASTM F844 washers for ASTM A307 bolts, and ASTM F436M washers for ASTM A325M and ASTM A490M bolts.

2.2.2 Foundation Anchorage

2.2.2.1 Bolts

ASTM A307.

2.2.2.2 Nuts

ASTM A563, Grade A, hex style.

2.2.2.3 Washers

ASTM F844.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1.

2.3.2 Nonshrink Grout

ASTM C1107, with no ASTM C827 shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded or on surfaces of weathering steels that will be exposed in the completed structure. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, or surfaces within 13 mm of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C; or when the primer may be exposed to temperatures below 4 degrees C within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 0.05 mm except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Fireproofing and Epoxy Coated Surfaces

Surfaces to receive sprayed-on fireproofing, epoxy coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07810, "Spray-Applied Fireproofing".

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under

the AISC FCD for Category A structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with AISC ASD Manual and primed with the specified paint.

3.2 ERECTION

- a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC ASD Manual. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.
- b. For the Company Operations Facilities (COF's 9, 10, 11, and 12), the erection plan shall conform to AISC S303 and the structure shall be erected in accordance with AISC Design Guide No. 10.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC S335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt and pin holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3.2 High-Strength Bolts

ASTM A325M bolts shall be installed in connection holes and initially brought to a snug tight fit.

3.4 WELDING

AWS D1.1. Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.7.1.2 Nondestructive Testing

The Government has the option to perform non-destructive tests. Test locations shall be selected by the Contracting Officer.

- a. Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Magnetic Particle	10
Dye Penetrant	10

3.7.2 Load Indicator Washers

3.7.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.38 mm gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.13 mm gap when the load indicator washer is placed under the turned element, as required by ASTM F959M.

3.7.3 High-Strength Bolts

3.7.3.1 Inspection

Inspection procedures shall be in accordance with AISC S329, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.4 Testing for Embrittlement

ASTM A143 for steel products hot-dip galvanized after fabrication.

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SECTION 05300A

STEEL DECKING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl (1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 780 (2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3 (1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphragm Mnl (1991) Diaphragm Design Manual

SDI Pub No. 29 (1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Deck Units
Accessories
Attachments
Holes and Openings

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded or fastener connections; and the manufacturer's erection instructions.

SD-03 Product Data

Deck Units

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

SD-04 Samples

Deck Units
Accessories

A 0.19 sq meter sample of the decking material to be used, along with a sample of each of the accessories used. A sample of acoustical material to be used shall be included.

SD-07 Certificates

Deck Units
Attachments

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck

units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No. 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 653/A 653M. Roof deck units shall be fabricated of the steel design thickness required by the design drawings and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class.

2.2 TOUCH-UP PAINT

Touch-up paint for zinc coated units shall be an approved galvanizing repair paint with a high-zinc dust content. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm (0.0474 inch); welding washers, 1.519 mm (0.0598 inch); cant strip, 0.749 mm (0.0295 inch); other metal accessories, 0.909 mm (0.0358 inch); unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Diaphragm Mnl and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 ATTACHMENTS

The deck units shall be welded with nominal 16 mm diameter puddle welds to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No. 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI Diaphragm Mnl.

3.3 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm (0.0474 inch) thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles

perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

3.4 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

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SECTION 05500A

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Ladders - Fixed - Safety Requirements

ANSI MH28.1 (1982) Design, Testing, Utilization, and Application of Industrial Grade Steel Shelving

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 26/B 26M (1999) Aluminum-Alloy Sand Castings

ASTM E 814 (2000) Fire Tests of Through-Penetration Fire Stops

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A39.1 (1995; A39.1a; A39.1b) Safety Requirements for Window Cleaning

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2000) Structural Welding Code - Steel

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (1998; Errata 10-98-1) Portable Fire Extinguishers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-344 (Rev B) Lacquer, Clear Gloss, Exterior, Interior

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates.

SD-04 Samples

Miscellaneous Metal Items.

Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness.

Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have anodized finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 ACCESS PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 1.52 mm (16 gauge) steel with welded joints and finished with anchorage for securing into construction. Size of access doors shall be as indicated and of not lighter than 1.9 mm (14 gauge) steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch unless otherwise indicated.

2.2 ACCESS DOORS FOR MECHANICAL FIXTURES

Access doors shall be stainless steel, shall be provided with frames, and unless otherwise indicated, shall be sized as indicated.

2.3 CORNER GUARDS

Corner guards shall be provided unprotected for corner of wall as indicated.

2.4 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.5 HANDRAILS

Handrails shall be designed to resist a concentrated load of 890 N (200 pounds) in any direction at any point of the top of the rail or 292 Newtons per meter (20 pounds per foot) applied horizontally to top of the rail, whichever is more severe.

2.5.1 Aluminum Handrails and Guardrails

Handrails and guardrails shall consist of top rail, bottom rail, and posts with minimum diameter of 40 mm (1-1/2 inch) and balusters with a minimum diameter of 20 mm (3/4 inch). Railings and pipe collars shall be anodized aluminum dark bronze color. All fasteners shall be series 300 stainless steel.

a. Jointing shall be by one of the following methods:

(1) Flush type rail fittings, welded and ground smooth with splice locks secured with 10 mm recessed head setscrews.

(2) Mitered and welded joints, made by fitting post to top rail and intermediate rail to post and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 150 mm in length. Dowel or sleeve shall be connected to one side of the splice by tack welding or by using epoxy cement.

(3) Railings shall be assembled using slip-on aluminum-magnesium alloy fittings for joints. Fittings shall be fastened to pipe or tube with 6 mm or 10 mm stainless steel recessed head setscrews.

Assembled railings shall be provided with fittings only at vertical supports or at rail terminations attached to walls. Expansion joints shall be at the midpoint of panels. A setscrew shall be provided in only one side of the slip-on sleeve. Alloy fittings shall conform to ASTM B 26/B 26M.

- b. Removable sections, toe-boards and brackets shall be provided where indicated, using flange castings as appropriate.

2.6 LADDERS

Ladders shall be galvanized steel or aluminum, fixed rail type in accordance with ANSI A14.3. Hot dip galvanized after fabrication.

2.7 MIRROR FRAMES

Frames for plate glass mirrors larger than 450 by 750 mm shall be fabricated from corrosion-resisting steel with satin finish. Frames shall be provided with concealed fittings and tamperproof mountings.

2.8 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.9 SAFETY NOSING

Safety nosings shall be of cast aluminum with plain, abrasive surface. Nosing shall be 75 mm wide and terminating at not more than 150 mm from the ends of treads. Safety nosings shall be provided with anchors not less than 19 mm long. Integrally cast mushroom anchors are not acceptable.

2.10 SHELVING

Shelving shall conform to ANSI MH28.1 and shall be provided as indicated. Minimum dimensions and number of shelves shall be as indicated.

2.11 WINDOW CLEANING ANCHORS

Window cleaning anchors shall be provided at all windows located on the highest floor of the Barracks buildings as indicated. Window cleaner anchors shall be manufactured of stainless-steel conforming to ASME A39.1. A minimum of two (2) anchors shall be provided at each window and shall be solidly anchored to the building construction as detailed on the drawings. Window cleaning anchors shall be "Fall Arrest Anchors, FARA-91", as manufactured by Thaler Roofing Specialties Products Inc." or approved equal. Location of window cleaner shall be as shown.

2.12 FIRE EXTINGUISHER CABINETS

Cabinets to be located in fire-rated walls shall be fire-rated type, fabricated in accordance with ASTM E 814, and shall be listed by an approved testing agency for 1-hour combustible and non-combustible wall

systems. The testing agency's seal shall be affixed to each fire-rated cabinet. Cabinets shall be of the recessed type suitable for 10 kg extinguishers. Box and trim shall be of heavy gage rolled steel. Door shall be a rigid frame with full length piano type hinge and double strength (DSA) glass panel. Door and panel shall be prime-coated inside and out and finish with field paint coating to match adjacent wall color.

2.13 WALL LOCKERS AND LOCKER BENCHES

2.13.1 Wall Lockers

Wall lockers shall double tier, 305 mm (12 inch) wide by 457 mm (18 inch) deep, by 914 mm (36 inches) high standard locker. All parts shall be made of mild cold rolled sheet with baked enamel finish. Locker doors and door frames shall be minimum 16 gauge steel. Locker doors shall have louvers on the face of each door. Lockers shall be provided with continuous sloping tops and number plates for locker. Standard lockers shall have one double prong back-hook and two single prong wall hooks in each compartment. Handle parts shall be made from sturdy zinc die cast material for attachment of padlock. Color of lockers and accessories shall be "Republic Storage System, 44 County Blue" or approval equal.

2.13.2 Locker Benches

Locker benches shall be made from laminated maple, 32 mm (1-1/4 inch) full finished thickness. All corners shall be rounded and sanded. Surfaces shall be finished with 2-coats of varnish. Bench tops shall be mounted on pedestals consisting of 32 mm (1-1/4 inch) O.D. tubing with 10 gauge steel flanges welded to each end. Color of pedestal shall be black.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 ACCESS DOORS AND PANELS

3.2.1 Access Doors

Access door shall be installed flush to drywall surfaces. Flange of door shall be attached to construction and concealed with drywall material.

3.3 REMOVABLE ACCESS PANELS

A removable access panel not less than 300 by 300 mm shall be installed to access valves, dampers, or air splitters that are located above the ceiling and water hammer arrestors in the walls as indicated.

3.4 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with

appropriate fasteners.

3.5 ATTACHMENT OF HANDRAILS AND GUARDRAILS

Brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints.

3.5.1 Installation of Aluminum Handrails and Guardrails

Installation shall be as indicated on the drawings. Ends of top rail shall be securely anchored to the wall. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

3.5.2 Installation of Aluminum Handrails

Installation shall be as indicated on the drawings.

3.6 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.7 INSTALLATION OF FIRE EXTINGUISHER CABINETS

Metal fire extinguisher cabinets shall be furnished and installed in accordance with NFPA 10 where shown on the drawings or specified.

3.8 INSTALLATION OF WALL AND LOCKER BENCHES

Wall lockers and locker benches shall be secured to the walls and floor slab using appropriate fasteners as recommended by the manufacturer's printed instructions.

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SECTION 06100A

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- 3.2 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS
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-- End of Section Table of Contents --

SECTION 06100A

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T101 (1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction

AF&PA T11 (1988) Manual for Wood Frame Construction
**

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307 (2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM C 1136 (1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM C 518 (1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 553 (1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 665 (1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM E 154 (1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM E 84 (2000a) Surface Burning Characteristics of Building Materials

ASTM E 96 (2000) Water Vapor Transmission of Materials

ASTM F 547 (1977; R 1995) Definitions of Terms
Relating to Nails for Use with Wood and
Wood-Based Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C20 (1999) Structural Lumber Fire-Retardant
Pressure Treatment

AWPA C27 (1999) Plywood - Fire-Retardant Pressure
Treatment

AWPA M4 (1999) Standard for the Care of
Preservative-Treated Wood Products

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM LPD 1-49 (1995) Loss Prevention Data Sheet -
Perimeter Flashing

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (1996; Supp. VII & VIII) Standard Grading
and Dressing Rules for Douglas Fir,
Western Hemlock, Western Red Cedar, White
Fir, Sitka Spruce Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules (1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Nailers and Nailing Strips

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Product Installations

List containing name and location of successful installation of similar type of fabricated structural members specified herein.

SD-07 Certificates

Grading and Marking

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation; Vapor Retarder

Certificate attesting that the cellulose, perlite, glass and mineral fiber, glass mat gypsum roof board, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWP A M4. Items of all-heart

material of cedar, cypress, or redwood will not require preservative treatment. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

a. Wood members exposed to the weather and those used in roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.

b. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 100 mm or less, nominal thickness, 19 percent maximum. 125 mm or more, nominal thickness, 23 percent maximum in a 75 mm perimeter of the timber cross-section.

b. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Fire-Retardant Treatment

Fire-retardant treated wood shall be pressure treated in accordance with AWPA C20 for lumber and AWPA C27 for plywood. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and B and Exterior Type. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating.

2.1.6 Miscellaneous Wood Members

2.1.6.1 Nonstress Graded Members

Members shall include furring and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size mm (inch)
Furring	25 (1) x 50 (2) or 75 (3)
Nailing strips	25 x 75 (1 x 3) or 25 x 100 (1 x 4) when used as shingle base or interior finish, otherwise 50 mm (2 inch) stock.

2.1.6.2 Blocking

Blocking shall be standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Clip Angles

Steel, 5 mm (3/16 inch) thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.2.4 Expansion Shields

Type and size best suited for intended use.

2.2.5 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. In general, 8-penny or larger nails shall be used for nailing through 25 mm thick lumber and for toe nailing 50 mm thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split.

If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown.

R-values shall be determined at 24 degrees C (75 degrees F) in accordance with ASTM C 518. Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing asbestos

will not be allowed.

2.3.1 Batt or Blanket

2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, Class A, having a UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84. Insulation shall have a 0.25 mm (10 mil) thick, white, puncture resistant woven-glass cloth with vinyl facing on one side. Width and length shall suit construction conditions.

2.3.1.2 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type I unfaced insulation.

2.3.1.3 Mineral Fiber Blanket

Mineral fiber blanket shall conform to ASTM C 553, Type I, Class 6. Blankets shall be sized to suit construction conditions, resilient type for use below and above ambient temperature to 195 degrees C. Blankets shall have a factory applied vapor-barrier facing on one side with 50 mm nailing tabs on both edges. Vapor barriers shall be fire retardant, high vapor transmission, and aluminum foil laminated to crepe paper type conforming to ASTM C 1136, Type II. Nominal density shall be 12 kg per cubic meter.

2.3.2 Rigid Insulation

Rigid insulation used in conjunction with roofing system shall be as specified in Section 07220a ROOF INSULATION.

2.3.3 Sound Barrier Insulation

Sound barrier insulation shall be as specified in Section 07210 SOUND BARRIER INSULATION.

2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 29 ng per Pa per second per square meter (0.5 perms) as determined in accordance with ASTM E 96, unless otherwise specified.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING

3.1.1 General

General framing shall be in accordance with AF&PA T11. Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place.

3.2 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.2.1 Blocking

Blocking shall be provided as necessary for application of siding, sheathing, wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 2400 mm for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

3.2.2 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed as indicated. Stacked nailers shall be assembled with spikes or nails spaced not more than 450 mm on center and staggered. Beginning and ending nails shall not be more than 150 mm for nailer end. Ends of stacked nailers shall be offset approximately 300 mm in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

3.2.3 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 400 mm on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.3 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the thermal resistance shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.4 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

3.5 TABLES

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
WCLIB 17					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
WWPA Grading Rules					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

-- End of Section --

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SECTION 06200A

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PART 2 PRODUCTS

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 - 2.1.1 Grading and Marking
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 - 2.1.3 Moisture Content
 - 2.1.4 Preservative Treatment
 - 2.1.4.1 Wood Molding and Millwork
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PART 3 EXECUTION

- 3.1 MOLDING BASE AND INTERIOR TRIM
- 3.2 TABLES

-- End of Section Table of Contents --

SECTION 06200A

FINISH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 547 (1977; R 1995) Definitions of Terms
Relating to Nails for Use with Wood and
Wood-Based Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA M4 (1999) Standard for the Care of
Preservative-Treated Wood Products

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for
Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS)

RIS GCRL (1987) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple No. 1, Aug 1993) Standard
Specifications for Grades of Southern
Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules (1994; Supple 8 thru 11) Standard Grading
Rules for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (1996; Supples VII(A-E), VIII(A-C))
Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules

(1999) Western Lumber Grading Rules 95

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6

(1987) Industry Standard for Non-Pressure
Treating of Wood Millwork

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Finish Carpentry

Drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

SD-04 Samples

Moldings and Base

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 WOOD ITEMS AND TRIM

The Contractor shall furnish products which optimize design by reducing the amount of wood used (engineered wood), by using recycled wood products and preservatives without arsenic or chromium when the products and methods are competitive in price or directed by the Contracting Officer.

2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of

authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Except for plywood, wood structural panels, and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

2.1.2 Sizes and Patterns

Lumber sizes and patterns shall conform to rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Sizes and patterns for materials other than lumber shall conform to requirements of the rules or standards under which produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Moisture Content

The maximum moisture content of untreated trim and wood siding shall be 15 percent at the time of delivery to the jobsite and when installed. Moisture content of all other material shall be in accordance with the standard under which the product is produced.

2.1.4 Preservative Treatment

2.1.4.1 Wood Molding and Millwork

Wood molding and millwork shall be preservative-treated in accordance with WMMPA WM 6. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWP4 M4. Items of all-heart material of cedar cypress, or redwood will not require preservative treatment, except when in direct contact with soil.

2.1.5 Trim

2.1.5.1 Wood

Trim shall be species and grade listed in TABLE I at the end of this section except that cherry wood and oak wood shall be premium first grade, vertical grain for natural finish. Sizes shall be as indicated.

2.2 NAILS

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. Screws for use where nailing is impractical shall be size best suited for purpose.

PART 3 EXECUTION

3.1 MOLDING BASE AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

3.2 TABLES

TABLE I. SPECIES AND GRADE TABLES

Grading Rules	Species	Choice	Clear	C Select	C & Better
NELMA Grading Rules					
	Eastern Cedar				X
	Eastern Hemlock		X		
	Tamarack				X
	Eastern W. Pine				X
	Northern Pine				X
	Eastern Spruce			X	
	Balsam Fir		X		
RIS GCRL	Redwood		X		
SCMA Spec	Cypress			X	
SPIB Rules	Southern Pine				X
WCLIB 17	Douglas Fir				X
	Larch				X
	Hemlock Fir				X
	Mountain Hemlock				X
	Sitka Spruce				X
WWPA Grading Rules					
	Douglas Fir				X
	Larch				X
	Hemlock Fir		X		
	Mountain Hemlock				X
	Western Larch		X		
	Idaho White Pine	X			
	Lodgepole Pine		X		
	Ponderosa Pine		X		
	Sugar Pine		X		
	Englemann Spruce		X		
	Douglas Fir South		X		
	Subalpine Fir		X		

NOTE 1: Western Cedar under WCLIB 17 shall be Grade B; and under WWPA Grading Rules, Western Cedar shall be Grade B bevel for siding and Grade A for trim.

NOTE 2: Except as specified in NOTE 3 below, siding and exterior trim

TABLE I. SPECIES AND GRADE TABLES

Grading Rules	Species	Choice	Clear	C Select	C & Better
shall be any of the species listed above. Interior trim shall be any one of the species listed above and the highest grade of the species for stain or natural finish and one grade below highest grade of species for paint finish.					

NOTE 3: Southern Yellow Pine, Douglas Fir, Larch, Western Larch, and Tamarack shall not be used where painting is required and may be used on exterior work only when approved and stained with a preservative type stain.

-- End of Section --

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SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

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 - 2.1.3 Material Patterns and Colors
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SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI Z124.3	(1995) Plastic Lavatories
ANSI Z124.6	(1997) Plastic Sinks

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 570	(1998) Water Absorption of Plastics
ASTM D 638M	(1998) Tensile Properties of Plastics (Metric)
ASTM D 696	(1998) Coefficient of Linear Thermal Expansion of Plastics Between Minus 30 degrees C and 30 degrees C
ASTM D 2583	(1995) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM G 22	(1976; R 1996) Determining Resistance of Plastics to Bacteria

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High Pressure Decorative Laminates
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1.2 GENERAL DESCRIPTION

Work in this section includes counters and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Shop Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material
Qualifications
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive and sealants. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Material

A minimum 100 by 100 mm sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

Counter and Vanity Tops

A minimum 300 mm wide by 150 mm deep, full size sample for each type of counter top shown on the project drawings. The sample shall include the edge profile and backsplash as detailed on the project drawings. Solid polymer material shall be of a pattern and color as indicated on the drawings. Sample shall include at least one seam. Approved sample shall be retained as

standard for this work.

SD-06 Test Reports

Solid polymer material

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

SD-07 Certificates

Fabrications
Qualifications

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

SD-10 Operation and Maintenance Data

Solid polymer material
Clean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided, if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

1.7 MOCK-UP

Prior to final approval of shop drawings, a full-size mock-up shall be provided of a typical vanity top and countertop where multiple units are required. The mock-up shall include all solid polymer components required to provide a completed unit. The mock-up shall utilize finishes in patterns and colors indicated on the drawings. Should the mock-up not be approved, the Contractor shall re-work or remake it until approval is secured. Rejected units shall be removed from the jobsite. Approved mock-up may remain as part of the finished work.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.25 mm shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 6 mm in thickness.

2.1.1 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	422 kg/cm ²	ASTM D 638M
Hardness	55-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.0000386cm/cm/degC	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
6.4 mm sheet	910 mm, 227 g ball, no failure	
12.7 mm sheet	3550 mm, 227 g ball, no failure	

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
19 mm sheet	5070 mm, 227 m ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 22
Liquid Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	

2.1.2 Acrylic-modified Polymer Solid Surfacing Material

Cast, solid polymer material shall be composed of a formulation containing acrylic and polyester polymers, mineral fillers, and pigments. Acrylic polymer content shall be not less than 5 percent and not more than 10 percent in order to meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	288 kg/cm ²	ASTM D 638M
Hardness	50-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.0000386cm/cm/degC	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
6.4 mm sheet	910 mm, 227 m ball, no failure	
12.7 mm sheet	3550 mm, 227 m ball, no failure	
19 mm sheet	507 mm, 227 m ball, no failure	

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 22
Liquid Absorption (Weight in 24 hrs.)	0.6% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	100 max	

2.1.3 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project drawings. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.4 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be as indicated on the drawings.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A136.1, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 13 mm thick solid surfacing material and shall be 100 mm high unless otherwise indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops and vanity tops. Backsplashes shall be shop fabricated and be permanently attached.

2.3.3.1 Permanently Attached Backsplash

Permanently attached backsplashes shall be attached straight with seam adhesive to form a 90 degree transition.

2.3.3.2 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 13 mm or 19 mm thick material as indicated on the drawings. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with 100 mm high permanently attached, 90 degree transition and loose endsplashes at

all locations. Attach 50 mm wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.4.1 Counter Top With Vitreous China Sink

Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

2.3.4.2 Vanity Tops With Vitreous China Bowl

Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of countertops, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

3.2 INSTALLATION

3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.2.1.1 Loose Counter Top Side Splashes

Loose splashes shall be mounted in locations as noted on the drawings.

Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made.

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SECTION 07131

ELASTOMERIC SHEET WATERPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1004	(1994; Rev. A) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1149	(1991; R 1999) Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 1204	(1994) Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 2240	(2000) Rubber Property - Durometer Hardness
ASTM D 297	(1993; R 1998) Rubber Products - Chemical Analysis
ASTM D 3045	(1992; R 1997) Practice for Heat Aging of Plastics Without Load
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 429	(1981; R 1993) Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
ASTM D 471	(1998e1) Rubber Property - Effect of Liquids
ASTM D 5385	(1993) Standard Test Method for Hydrostatic Pressure Resistance of

	Waterproofing Membranes El-2000 R(2000)
ASTM D 570	(1998) Water Absorption of Plastics
ASTM D 573	(1988; R 1999) Rubber - Deterioration in an Air Oven
ASTM D 624	(2000) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 638	(1999) Tensile Properties of Plastics
ASTM D 751	(2000) Coated Fabrics
ASTM D 903	(1998) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 96	(2000) Water Vapor Transmission of Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Elastomeric waterproofing sheet material; G

Protection board

Primers, adhesives, and mastics

SD-04 Samples

Inner and field condition

Attachment to existing waterproof sheeting

SD-06 Test Reports

Elastomeric waterproofing sheet material

Certify compliance with performance requirements specified herein.

SD-08 Manufacturer's Instructions

Submit Manufacturer's material safety data sheets for primers, adhesives and mastics.

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawing Requirements

Include description and physical properties; termination details; application details; recommendations regarding shelf life, application procedures; requirements for protective covering; and precautions for flammability and toxicity.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Do not permit uncertified materials in the work area.

1.5 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is surface moisture, or visible dampness on the surface to receive waterproofing.

PART 2 PRODUCTS

2.1 MATERIALS

Provide one of the types of elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials within a specific type, with each other, and with the materials on which they will be applied. Materials shall conform to the applicable performance requirements cited below when tested in accordance with the referenced ASTM publications.

2.2 BUTYL RUBBER SHEETING

Not less than 1.5 mm minimum thickness.

2.2.1 Butyl Rubber Sheeting Performance Requirements

- a. Thickness Tolerance, ASTM D 412: Plus or minus 10 percent;
- b. Specific Gravity, ASTM D 297: 1.20, plus or minus 0.05;
- c. Tensile Strength, ASTM D 412: 7.7 MPa minimum;
- d. Tensile Stress at 300 percent elongation, ASTM D 412: 3.85 MPa minimum;
- e. Elongation, ASTM D 412: 300 percent minimum;

- f. Tear Resistance, Die C, ASTM D 624: 26.3 newtons per millimeter (N/mm) minimum;
- g. Shore A Hardness, ASTM D 2240: Five-second interval before reading; 60 plus or minus 10;
- h. Ozone Resistance, ASTM D 1149: No cracks, 7 days - 50 pphm - 37.8 degrees C, 20 percent elongation;
- i. Heating Aging-Accelerated, ASTM D 573: Tensile retention, 60 percent of minimum original elongation retention; 60 percent of minimum original requirement; 7 days, 115.6 degrees C;
- j. Butyl Identification, ASTM D 471, Tricresyl Phosphate Immersion: Maximum volume swell 10 percent, 70 hrs, 100 degrees C;
- k. Water Absorption, ASTM D 471: +1 percent maximum. 7 days, 70 degrees C;
- l. Exposure to Fungi and Bacteria in Soil, ASTM E 154, Minimum 16 Weeks: Unaffected; and
- m. Water Vapor Transmission, 26.7 Degrees C Permeance, ASTM E 96, Procedure B or BW: 8.58×10^{-7} g/Pa.s.m² maximum.

2.2.2 Adhesive, Cement, and Tape for Use with Butyl Rubber

As recommended by the butyl rubber waterproofing membrane manufacturer.

2.3 THERMOPLASTIC MEMBRANE: POLYVINYL CHLORIDE (PVC)

Polyvinyl chloride (PVC) flexible sheets with non-woven fiberglass reinforcing not less than 1.5 mm minimum thickness.

2.3.1 Thermoplastic Membrane Performance Requirements

- a. Overall thickness, ASTM D 751:, 1.50 mm min.;
- b. Tensile strength ASTM D 638:, 11.03 MPa, min.;
- c. Elongation at break, ASTM D 638:, 250 percent minimum;
- d. Seam strength, ASTM D 638:, 90 percent minimum of tensile strength;
- e. Retention of properties after heat aging, ASTM D 3045;
- f. Tensile strength, ASTM D 638:, 95 percent of original;
- g. Elongation, ASTM D 638:, 95 percent of original;
- h. Tear resistance, ASTM D 1004:, 7.7 Kilogram Force,;
- i. Liner Dimensional Change, ASTM D 1204: 0.002 percent; and

- j. Weight Change After Immersion in Water, ASTM D 570:, 2.0 percent maximum.

2.3.2 Adhesives

- a. Adhesive for thermoplastic flashings as recommended by manufacturer.
- b. Adhesive for Sub-Membrane Grid: 100% solids, two-part urethane, with minimum tensile strength of 1.04 MPa, , in accordance with ASTM D 412 and adhesion to concrete of 12 ply in accordance with ASTM D 429 as recommended by manufacture.

2.3.3 Accessories

- a. Securement Strip: 14 gauge stainless steel metal bar, 2.54 cm wide, pre-punched 2.54 cm on center for securement.

2.4 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 1.5 mm minimum thickness is required.

2.4.1 Composite, Self-Adhering Sheeting Performance Requirements

- a. Tensile Strength, ASTM D 412, Die C: 1.6 MPa minimum;
- b. Ultimate Elongation, ASTM D 412, Die C: 200 percent minimum;
- c. Water Vapor Transmission, ASTM E 96 26.7 Degrees C Permeance, Procedure B: 5.72×10^{-7} g/Pa.s.m² maximum;
- d. Cycling Over Crack at Minus -26 degrees C: Membrane is applied and rolled across two primed concrete blocks with no separation between blocks. Crack opened and closed from zero to 6 mm. No effect at 100 cycles;
- e. Puncture Resistance, ASTM E 154: 18 kg minimum;
- f. Lap Adhesion at Minimum Application Temperature, ASTM D1876 Modified, 880 N/m (5 lbs/in.);
- g. Peel Strength, ASTM D 903: Modified, 1576 N/m, ;
- h. Resistance to Hydrostatic Head, ASTM D 5385:, 70 m, of water
- i. Water Absorption, ASTM D 570; 0.1% maximum.

2.4.2 Primer

Asphalt composition, ASTM D 41, or synthetic polymer in solvent as recommended by the membrane manufacturer.

2.4.3 Mastic

Polymer modified asphalt in suitable solvent of trowel-grade consistency and as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify that surfaces to be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to be treated are clean, dry, smooth, and free from deleterious materials and projections. Cut off high spots or grind smooth, to a steep bevel with Portland cement mortar. Sweep surfaces to be covered before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.3 APPLICATION

Follow manufacturer's printed installation instructions. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor. Provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces as indicated and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

- a. Non-Self-Adhering Membrane: Unroll membrane and allow to remain flat for at least one-half hour before application. Apply an asphalt concrete primer prior to application of asphaltic adhesive. Where solvent adhesive is applied, allow major portion of solvent to evaporate so that bonding adhesive does not stick to a dry finger touching it. Apply elastomeric waterproofing membrane in a full bed of adhesive at a uniform coverage rate in accordance with the recommendations in the membrane manufacturer's printed instructions. Where membrane on horizontal surfaces are to receive concrete fill, apply adhesive in 100 mm wide strips at 600 mm on center. Pull membrane tight without stretching. As soon as adhesive is fully set and dry, recheck lap splices. Where openings or fishmouths appear, reseal and reroll lap splices.
- b. Self-Adhering Membrane: Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.
- c. Protection: Protect membrane over horizontal surfaces from abnormal traffic during installation. Use only equipment with rubber tires. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on membrane.

3.3.1 Butyl Rubber

Lap sheets at sides and ends a minimum of 150 mm over the preceding sheet. Apply lap splicing cement over entire 150 mm splice area prior to application of sealant. Sealant shall be continuous along the entire length of the splice. Maintain a continuous bead of sealant at all membrane splices or as required by the manufacturer. When membrane will be below water table, provide a tongue and groove cemented splice a minimum of 150 mm with factory made heat vulcanized seam not less than 50 mm or as required by the manufacturer.

3.3.2 Thermoplastic Membrane (PVC)

Deck shall be clean, smooth and dry without surface irregularities. Consult with membrane manufacturer prior to grid application. Install 30.48 cm wide sub-membrane containment grid as required by manufacturer. Provide and install the containment grid at intervals across the width and length of the substrate, at the base of all transitions, walls, curbs, penetrations, and at the perimeter of each deck/substrate section. Fully adhere strips to the deck in a full bedding of two-part urethane adhesive medium. Adjacent sheets shall be welded in accordance with manufacturer's instructions. All side and end lap joints shall be hot-air welded. Lap area shall be a minimum of 7.62 cm wide when machine welding, and a minimum of 10.16 cm wide when hand welding but not less than recommended by the manufacturer. Overlaps shall be with the flow of water.

3.4 Composite, Self-Adhering Membrane

Lap sheets at edges and ends a minimum of 65 mm over the preceding sheet. All side laps shall be minimum 65 mm and end laps shall be , 127 mm. Laps shall be self adhesive, mastic as per manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with two layers of reinforcement by first applying a 300 mm width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 150 mm from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a trowelled bead of mastic. Apply mastic around edges of membrane, and drains and projections. Apply mastic at end of each work day.

3.5 FIELD QUALITY CONTROL

Notify the Contracting Officer one day prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 75 mm of ponded water for 24 hours. Do not add water after start of 24 hour period. Carefully measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of Contracting Officer.

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SECTION 07132A

BITUMINOUS WATERPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 449	(1989; R 1999e1) Asphalt Used in Dampproofing and Waterproofing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Applications

Manufacturer's installation instructions, before delivery of materials to the site. Instructions shall specify acceptable range of asphalt application temperatures and the maximum temperature for holding asphalt in a heated condition.

SD-07 Certificates

Materials

Certificates from manufacturer attesting that asphalt manufactured and shipped to jobsite meets the specified requirements.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous waterproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Waterproofing materials shall be delivered to the project site in the original sealed containers bearing the name of the manufacturer, contents and brand name. Asphalt shall be protected from freezing in a weathertight enclosure. Reinforcement fabrics shall be protected from moisture damage and moisture absorption in a weathertight enclosure or shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup and therefore shall not be used to cover waterproofing materials. Damaged or deteriorated materials shall be removed from project site.

PART 2 PRODUCTS

2.1 ASPHALT WATERPROOFING

2.1.1 Primer

Primer for hot-applied asphalt waterproofing shall conform to ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

2.1.2 Above-Grade Hot-Applied Asphalt

For above-grade applications where asphalt will not be exposed to temperatures exceeding 50 degrees C, hot-applied asphalt for membrane waterproofing system shall conform to ASTM D 449, Type II. For above-grade applications where asphalt will be exposed to sunlight and temperatures exceeding 50 degrees C, hot-applied asphalt shall conform to ASTM D 449, Type III.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous waterproofing shall be prepared in accordance with waterproofing manufacturer's recommendations. Surface preparation shall be approved prior to waterproofing application.

3.1.1 Protection of Surrounding Areas

Before starting the waterproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

3.2 HOT-APPLIED ASPHALT WATERPROOFING

Asphalt waterproofing shall be applied when the ambient temperature is 4 degrees C or above. Heating kettles and tanks shall be provided with automatic thermostatic control capable of maintaining asphalt temperature. Controls shall be calibrated and maintained in working order for duration of work. At time of application, asphalt shall not be heated above the equiviscous temperature (EVT) recommended by manufacturer. Immediately before use, temperature shall be measured with a portable thermometer at the point of application. EVT and flashpoint temperatures of asphalt in kettle shall be conspicuously posted on kettle. Asphalt with a temperature not conforming to the manufacturer's recommendations shall be returned to the kettle. Asphalt overheated by more than 10 degrees C for more than 1 hour shall be removed from site.

3.3 CLEAN-UP

Surfaces of other work which are stained with waterproofing materials shall be cleaned with a cleaner recommended by waterproofing manufacturer.

3.4 PROTECTION OF COMPLETED WORK

3.4.1 Wall Waterproofing

Waterproofing system not covered with protection board shall be protected to prevent damage from subsequent building operations. Installed boards shall not remain exposed at the end of a work day.

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SECTION 07210

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SECTION 07210

SOUND BARRIER INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153	Zinc Coating (Hot-Dip on Iron and Steel Hardware)
ASTM C 665	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fastening Spacing.

Drawings and installation details for wall and ceiling fastening.

SD-07 Certificates

Inspection.

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-08 Manufacturer's Instructions

Application of Insulation.

Insulation manufacturer's recommendations for the application

and installation of insulation.

1.3 STORAGE OF MATERIALS

Insulation shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation shall be permanently removed from the site. Felts shall be stacked on end 1 level high. Exposed materials shall be covered with a breathable material (tarpaulin) to prevent the build up of condensation. Shrink wrap should be cut to minimize condensation collection pressure in stored material.

PART 2 PRODUCTS

2.1 INSULATION

Insulation shall contain the highest practicable percentage of material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing asbestos will not be allowed.

2.1.1 Noise Barrier Batt

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation 89 mm Class A, having UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84. Width and length shall suit construction conditions.

2.1.2 Duct Liner Board

Semi-rigid, 50 mm in thickness, coated with black-pigmented, fire resistive coating, meeting ASTM E 84 for flame spread rating of 25 or less and smoke developed rating of 50 or less.

2.2 MISCELLANEOUS MATERIAL

2.2.1 Adhesive

As recommended by insulation manufacturer, for application of duct liner board to substrate.

2.2.2 Mechanical Fasteners

Prong-type, with 50 mm by 50 mm by 0.76 mm thick perforated base plate and 19 mm by 0.73 thick prong of cold-rolled carbon steel, with slotted type washers, all of galvanized steel. Lengths shall be provided to secure 50 mm duct liner boards.

2.2.3 Wire Mesh

Galvanized wire, 1.6 mm diameter, in 50 mm by 50 mm mesh size.

2.2.4 Metal Stays

Galvanized steel bar, 25 mm by 3 mm thickness, prime painted black.

2.2.5 Galvanizing

All steel components in these paragraphs shall be hot-dip galvanized in accordance with ASTM A 153, Class D.

PART 3 EXECUTION

3.1 PREPARATION REQUIREMENTS

Surfaces and conditions under which sound barrier insulation is to be installed shall be examined. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable for proper installation.

3.2 INSTALLATION

3.2.1 Noise Barrier Batts

Insulation shall be installed by pressing in place for a friction-fit between studs and laid on ceilings as indicated.

3.2.2 Mechanical Fasteners

Mechanical fasteners shall be applied to walls on gypsum wallboard substrate and to ceiling on concrete substrate using adhesives recommended by the manufacturer. Fasteners shall be spaced in accordance with the duct liner board manufacturer's recommendations and prepared shop drawings.

3.2.3 Duct Liner Board on Walls and Ceiling

Adhesives recommended by the duct liner board manufacturer shall be applied to walls on gypsum wallboard substrate and to ceilings on concrete substrate. Duct liner board shall be arranged with black facing exposed and impaled over the mechanical fasteners and pressed for full contact with adhesive. The prongs shall be clipped flush with the slotted washers.

3.2.4 Wire Mesh

Wire mesh shall be installed over the exposed duct liner boards at walls only as indicated on the drawings and shall be anchored in place with the flat bar stays.

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SECTION 07220A

ROOF INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
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FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513	(2002) Loss Prevention Data for Roofing Contractors
FM P7825a	(2002) Approval Guide Fire Protection
FM P7825c	(2002) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2003) Building Materials Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Application of Insulation

Insulation manufacturer's recommendations for the application and installation of insulation.

Inspection

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-07 Certificates

Insulation

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material.

1.3 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, shall be permanently removed from the site.

1.4 FIRE CLASSIFICATION

Insulation shall have been tested as part of a roof construction assembly of the type used in this project, and the construction shall be listed as Fire-Classified in UL Bld Mat Dir or Class I in FM P7825a.

PART 2 PRODUCTS

2.1 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Insulation shall be one, or a combination of the following materials:

2.1.1 Composite Board Insulation

Composite board insulation shall be polyisocyanurate faced with perlite insulation conforming to ASTM C 1289 Type III.

2.2 FASTENERS

Fasteners shall be specifically designed screws and plates or spikes and plates of sufficient length to hold insulation securely in place. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 534 N (120 lbs.) each in steel deck. Fasteners for steel decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 2.87 kPa (60 psf) at buildings up to 2 stories.

2.3 WOOD NAILERS

Wood nailers shall conform to Section 06100a ROUGH CARPENTRY, including

preservative treatment. Edge nailers shall be not less than nominal 150 mm wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 75 mm wide by the full thickness of the insulation.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be glaze coated when more than one day is required to finish the roofing. Phased construction will not be permitted.

3.2 ENVIRONMENTAL CONDITIONS

The temperature of the roofing materials shall be as required by the manufacturer. There shall be no moisture on the roof deck when the insulation and roofing are installed. Wind conditions shall be suitable for installation of insulation:

3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Substrate surface shall be smooth, clean, and dry at time of application.

3.4 INSTALLATION OF WOOD NAILERS

Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer.

3.5 APPLICATION OF INSULATION

Insulation shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 6 mm. Joints in successive layers shall be staggered with respect to joints of preceding layer. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is covered the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.5.1 Mechanical Fastening

On steel decks, for any slope exceeding 42 mm/m, multiple layers of insulation shall be mechanically fastened. Method of attachment shall be in accordance with recommendations of the insulation manufacturer and

requirements specified.

3.5.2 Steel Decks

All steel decks shall be insulated before receiving a roof membrane. Uninsulated steel decks shall have insulation applied to span the steel deck flutes and to act as an underlayment for the roof membrane. First layer of insulation on steel deck shall be compatible with mechanical fastening and shall meet fire resistant requirements.

3.5.3 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to indicated live load limits of roof construction.

3.6 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM P9513.
- c. Verification of proper storage and handling of insulation materials before, during, and after installation.
- d. Inspection of mechanical fasteners; type, number, length, and spacing.
- e. Coordination with other materials, cants, and nailing strips.
- f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- g. Installation of cutoffs and proper joining of work on subsequent days.
- h. Continuation of complete roofing system installation to cover

insulation installed same day.

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SECTION 07240

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SECTION 07240

EXTERIOR FINISH SYSTEMS (EFS)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 150	(2000) Portland Cement
ASTM C 473	(2000) Physical Testing of Gypsum Panel Products
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1186	(1999; Rev. A) Flat Non-Asbestos Fiber-Cement Sheets
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 2247	(1999) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 3273	(2000) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E 84	(2000) Surface Burning Characteristics of Building Materials
ASTM E 136	(1999) Behavior of Materials in Vertical Tube Furnace at 750 Degrees C
ASTM E 331	(2000) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

EXTERIOR INSULATION MANUFACTURERS ASSOCIATION (EIMA)

EIMA TM 101.01	(1995) Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EFS), Class PB.
EIMA TM 101.86	(1995, Rev. Aug. 1995) Resistance of Exterior Insulation and Finish Systems, Class PB, to the Effects of Rapid Deformation (Impact)
EIMA TM 105.01	(1995) Alkali Resistance of Glass Fiber Reinforcing Mesh for Use in Exterior Insulation and Finish Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 268	(1996) Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
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1.2 SYSTEM DESCRIPTION AND REQUIREMENTS

The exterior finish system (EFS) shall be a job-fabricated exterior wall covering consisting of sheathing, reinforcing fabric, base coat, finish coat, adhesive and mechanical fasteners as applicable. The system components shall be compatible with each other and with the substrate as recommended or approved by, and the products of, a single manufacturer regularly engaged in furnishing Exterior Insulation and Finish Systems. All materials shall be installed by an applicator approved by the system manufacturer. EFS shall be Class PB and match finish color and texture to adjacent barracks building.

1.2.1 System Requirements and Tests

The system shall meet the performance requirements as verified by the tests listed below. Where a wall system of similar type, size, and design as specified for this project has been previously tested under the condition specified herein, the resulting test reports may be submitted in lieu of job specific tests.

1.2.1.1 Water Penetration

Test the system for water penetration by uniform static air pressure in accordance with ASTM E 331. There shall be no penetration of water beyond the plane of the base coat/EPS board interface after 15 minutes at 300 Pa (, or 20% of positive design wind pressure, whichever is greater.

1.2.2 Component Requirements and Tests

The components of the system shall meet the performance requirements as verified by the tests listed below.

1.2.2.1 Surface Burning Characteristics

Conduct ASTM E 84 test on samples consisting of insulation board, base coat, reinforcing fabric, and finish coat. Cure for 28 days. The flame spread index shall be 25 or less and the smoke developed index shall be 450 or less.

1.2.2.2 Radiant Heat

The system shall be tested in accordance with NFPA 268 with no ignition during the 20-minute period.

1.2.2.3 Impact Resistance

Class PB Systems: Hemispherical Head Test; 28 day cured specimen of PB EFS in accordance with EIMA TM 101.86. The test specimen shall exhibit no broken reinforcing fabric per EIMA TM 101.86 at an impact of 25.49 in/lb..

1.2.3 Sub-Component Requirements and Tests

Unless otherwise stated, the test specimen shall consist of reinforcement, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the insulation board to be used on the building.

For mildew resistance, only the finish coat is applied onto glass slides for testing. These specimen shall be suitably sized for the apparatus used and be allowed to cure for a minimum of 28 days prior to testing.

1.2.3.1 Abrasion Resistance

Test in accordance with ASTM D 968, Method A. Test a minimum of two specimen. After testing, the specimens shall show only very slight smoothing, with no loss of film integrity after 500 liters of water.

1.2.3.2 Accelerated Weathering

Test in accordance with ASTM G 23, Method 1. After 2000 hours specimens shall exhibit no visible cracking, flaking, peeling, blistering, yellowing, fading, or other such deterioration.

1.2.3.3 Mildew Resistance

Test in accordance with ASTM D 3273. The specimen shall consist of the finish coat material, applied to clean 75 mm by 100 mm glass slides and shall be allowed to cure for 28 days. After 28 days of exposure, the specimen shall not show any growth.

1.2.3.4 Salt Spray Resistance

Test in accordance with ASTM B 117. The specimen shall be a minimum of 100 mm by 150 mm and shall be tested for 300 hours. After exposure, the specimen shall exhibit no observable deterioration, such as chalking, fading, or rust staining.

1.2.3.5 Water Resistance

Test in accordance with ASTM D 2247. The specimen shall be a minimum of 100 mm by 150 mm . After 14 days, the specimen shall exhibit no cracking, checking, crazing, erosion, blistering, peeling, or delamination.

1.2.3.6 Absorption-Freeze/Thaw

Class PB systems shall be tested in accordance with EIMA TM 101.01 for 60 cycles of freezing and thawing. No cracking, checking, or splitting, and negligible weight gain. After testing, the specimens shall exhibit no cracking or checking, and have negligible weight gain.

1.2.3.7 Sample Boards

Unless otherwise stated, provide sample EFS Component 300 by 600 mm (, on sheathing board, including finish color and texture, typical joints and sealant. If more than one color, finish, or pattern is used, provide one sample for each. The test specimen shall consist of reinforcement, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the fiber reinforced cement board to be used on the building.

1.2.4 Moisture Analysis

Perform a job specific vapor transmission analysis based on project specific climate and specified wall components and materials. Indicate the temperatures and relative humidities for the inside and outside of the building; a complete listing of the building components, their thickness, thermal resistance and permeance, as well as building location and use. If a mathematical model was used for the analysis, include the name of the model and the supplier/developer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop drawings; G

Show wall layout, construction and expansion joints, decorative grooves, layout of sheathing board, and reinforcement mesh and strip reinforcing fabric; joint and flashing details; details at wall penetrations; types and location of fasteners; details at windows and doors; and details at base, roof, corners.

SD-03 Product Data

Sheathing board

Adhesive

Mechanical Fasteners

Accessories

Base coat

Portland cement

Reinforcing fabric

Finish coat

Joint Sealant

Primer

Bond breaker

Backer Rod

Warranty

Include joint and other details, such as end conditions, corners, windows, parapet. Include shelf life and recommended cleaning solvents in data for sealants. Include material safety data sheets (MSDS) for all components of the EFS. The MSDS shall be available at the job site.

SD-04 Samples

Sample Boards; G

Color and Texture

SD-05 Design Data

Moisture analysis Calculations

SD-06 Test Reports

Abrasion resistance

Accelerated weathering

Impact resistance

Mildew resistance

Salt spray resistance

Water vapor transmission

Absorption-freeze-thaw

Flame spread

Water resistance

Flame spread

Surface Burning Characteristics

Radiant heat

substrate

SD-07 Certificates

Qualifications of EFS Manufacturer

Qualification of EFS Installer

Qualification of Sealant Applicator

Certify that EFS installer meets requirements specified under paragraph "Qualification of Installer," and that sealant applicator is approved by the EFS Manufacturer.

Qualifications of Third Party Inspector

Submit evidence that third party inspector has current certification from the Exterior Design Institute or equal inspector certification as inspector for the installation of EFS.

Inspection Check List; G

Submit filled-out inspection check list as required in paragraph "Quality Control," certifying that the installation of critical items meets the requirements of this specification.

SD-08 Manufacturer's Instructions

Installation

Manufacturer's standard printed instructions for the installation of the EFS. Include requirements for condition and preparation of substrate, installation of EFS, and requirements for sealants and sealing.

SD-10 Operation and Maintenance Data

EFS

Include detailed finish repair procedures and information regarding compatibility of sealants with base and finish coatings.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of EFS Manufacturer

The EFS shall be the product of a manufacturer who has been in the practice of manufacturing and designing EFS for a period of not less than 3 years, and has been involved in at least five projects similar to this project in size, scope, and complexity, in the same or a similar climate as this project.

1.4.2 Qualification of EFS Installer

The EFS Installer shall be trained and approved by the EFS manufacturer to install the system and shall have successfully installed at least five projects at or near the size and complexity of this project. The contractor shall employ qualified workers trained and experienced in installing the manufacturer's EFS.

1.4.3 Qualification of Sealant Applicator

The sealant applicator shall be experienced and competent in the installation of high performance industrial and commercial sealants and shall have successfully installed at least five projects at or near the size and complexity of this project.

1.4.4 Pre-Installation Conference

After approval of submittals and before commencing any work on the EFS, including installation of any sheathing board, and associated work, the Contracting Officer will hold a pre-installation conference to review:

- a. Drawings, specifications, and samples;
- b. Procedure for on site inspection and acceptance of EFS substrate and pertinent details (for example, mock-up installation);
- c. Contractor's plan for coordination of work of the various trades involved in providing EFS system and other components;
- d. Inspection procedures; and
- e. Safety requirements.

Pre-installation conference shall be attended by the Contractor, EFS Q.C. Specialist (EFS Inspector), and all personnel directly responsible for installation of the EIF system, including sealant applicator, and personnel responsible for related work, such as flashing and sheet metal, windows and doors, and a representative of the EFS manufacturer. Before beginning EFS work, the contractor shall confirm in writing the resolution of conflicts among those attending the preinstallation conference.

1.5 DELIVERY AND STORAGE

Deliver materials to job site in original unopened packages, marked with

manufacturer's name, brand name, and description of contents. Store materials off the ground and in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area. Protect stored materials from rain, sunlight, and excessive heat. Keep coating materials which would be damaged by freezing at a temperature not less than 4 degrees C. Do not expose insulation board to flame or other ignition sources.

1.6 ENVIRONMENTAL CONDITIONS

- a. Do not prepare materials or apply EFS during inclement weather unless appropriate protection is provided. Protect installed materials from inclement weather until they are dry.
- b. Apply sealants and wet materials only at ambient temperatures of 4 degrees C or above and rising, unless supplemental heat is provided. The system shall be protected from inclement weather and to maintain this temperature for a minimum of 24 hours after installation.
- c. Do not leave insulation board exposed to sunlight after installation.

1.7 WARRANTY

Furnish manufacturer's standard warranty for the EFS. Warranty shall run directly to Government and cover a period of not less than 5 years from date Government accepted the work.

PART 2 PRODUCTS

2.1 COMPATIBILITY

Provide all materials compatible with each other and with the substrate, and as recommended by EFS manufacturer.

2.2 SHEATHING BOARD

2.2.1 Fiber Reinforced Cement Sheathing Board

- a. Meet ASTM C 1186, Type B, Grade I.
- b. Non-combustible per ASTM E 136.
- c. Nail Pull Resistance: No less than 534 N (120 lbf) when tested in accordance with ASTM C 473.
- d. Thickness no less than 13 mm
- e. Water Absorption not to exceed 17 percent.

2.3 ADHESIVE

Manufacturer's standard product, including primer as required, and shall be compatible with substrate and insulation board to which the system is

applied.

2.4 MECHANICAL FASTENERS

Corrosion resistant and as approved by EFS manufacturer. Select fastener type and pattern based on applicable wind loads and substrate into which fastener will be attached, to provide the necessary pull-out, tensile, and shear strengths.

2.5 BASE COAT

Manufacturer's standard product and compatible with other systems components.

2.6 PORTLAND CEMENT

Conform to ASTM C 150, Type I or II as required, fresh and free of lumps, and approved by the systems manufacturer.

2.7 REINFORCING FABRIC

Reinforcing fabric mesh shall be alkali-resistant, balanced, open weave, glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other system materials, and comply with EIMA TM 105.01 and as recommended by EFS manufacturer.

2.8 FINISH COAT

Manufacturer's standard product conforming to the requirements in the paragraph on Sub-Component Requirements and Tests. For color consistency, use materials from the same batch or lot number. Finish color shall match existing building exterior color.

2.9 PRIMER

Non-staining, quick-drying type recommended by sealant manufacturer and EFS manufacturer.

2.10 ACCESSORIES

Conform to recommendations of EFS manufacturer, including trim, edging, anchors, expansion joints. All metal items and fasteners to be corrosion resistant.

2.11 JOINT SEALANT

Non-staining, quick-drying type meeting ASTM C 920, Class 25, compatible with the finish system type and grade, and recommended by both the sealant manufacturer and EFS manufacturer.

2.12 BOND BREAKER

As required by EFS manufacturer and recommended by sealant manufacturer and EFS manufacturer.

2.13 BACKER ROD

Closed cell polyethylene free from oil or other staining elements and as recommended by sealant manufacturer and EFS manufacturer. Do not use absorptive materials as backer rod. The backer rod should be sized 25 percent larger than the width of the joint.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrate and existing conditions to determine that the EFS can be installed as required by the EFS manufacturer and that all work related to the EFS is properly coordinated. Surface shall be sound and free of oil, loose materials or protrusions which will interfere with the system installation. If deficiencies are found, notify the Contracting Officer and do not proceed with installation until the deficiencies are corrected. The substrate shall be plane, with no deviation greater than 6 mm when tested with a 3 m straightedge. Determine flatness, plumbness, and any other conditions for conformance to manufacturer's instructions.

3.2 SURFACE PREPARATION

Prepare existing surfaces for application of the EFS to meet flatness tolerances and surface preparation according to manufacturer's installation instructions but provide a flatness of not more than 6 mm in 3000 mm (1/4 inch in 10 feet). Provide clean surfaces free of oil and loose material without protrusions adversely affecting the installation of the insulation board. For adhesively attached EFS, existing deteriorated paint must be removed. Due to substrate conditions or as recommended by the system manufacturer, a primer may be required. Apply the primer to existing surfaces as recommended by the manufacturer. Use masking tape to protect areas adjacent to the EFS to prevent base or finish coat to be applied to areas not intended to be covered with the EFS. The contractor shall not proceed with the installation until all noted deficiencies of the substrate are corrected.

3.3 INSTALLATION

Install EFS as indicated, comply with manufacturer's instructions except as otherwise specified, and in accordance with the shop drawings. EFS shall be installed only by an applicator trained and approved by the EFS manufacturer. Specifically, include all manufacturer recommended provisions regarding flashing and treatment of wall penetrations.

3.3.1 Sheathing Board

Edges and ends of boards shall be butted snugly with vertical joints staggered to provide full and even support from the supporting member. Do not align sheathing board joints with wall openings. Provide support at both vertical and horizontal joints. Attach sheathing board to metal studs with self-tapping drywall screws, with corrosion resistant metal fastener. Place fasteners sufficiently close to support imposed loads, but not more

than:

200 mm (8 inches) apart on each supporting stud

3.3.2 Base Coat and Reinforcing Fabric Mesh,

3.3.2.1 Class PB Systems

Mix base coat in accordance with the manufacturer's instructions manufacturer and provide any other reinforcement recommended by EFS manufacturer. Trowel the reinforcing fabric mesh into the wet base coat material. Fully embed the mesh in the base coat. When properly worked-in, the pattern of the reinforcing fabric mesh shall not be visible. Provide diagonal reinforcement at opening corners. Back-wrap all terminations of the EFS. Overlap the reinforcing fabric mesh a minimum of 50 mm on previously installed mesh, or butted, in accordance with the manufacturer's instructions. Install reinforcing fabric in accordance with and manufacturer's instructions.

3.3.3 Finish Coat

Apply and level finish coat in one operation. Obtain final texture by trowels, floats, or by spray application as necessary to achieve the required finish matching approved sample. Apply the finish coat to the dry base coat maintaining a wet edge at all times to obtain a uniform appearance. The thickness of the finish coat shall be in accordance with the system manufacturer's current published instructions. Apply finish coat so that it does not cover surfaces to which joint sealants are to be applied. The base coat/reinforcing mesh must be allowed to dry a minimum of 24 hours prior to the application of the finish coat. Surface irregularities in the base coat, such as trowel marks, board lines, reinforcing mesh laps, etc., shall be corrected prior to application of the finish coat.

3.4 JOINT SEALING

Seal EFS at openings as recommended by the system manufacturer. Apply sealant only to the base coat. Do not apply sealant to the finish coat.

3.4.1 Surface Preparation, Backer Rod, and Primer

Immediately prior to application, remove loose matter from joint. Ensure that joint is dry and free of paint, finish coat, or other foreign matter. Install backer rod. Apply primer as required by sealant and EFS manufacturer. Check that joint width is as shown on drawings but in no case shall it be less than 13 mm for perimeter seals and 20 mm for expansion joints. The width shall not be less than 4 times the anticipated movement. Check sealant manufacturer's recommendations regarding proper width to depth ratio.

3.4.2 Sealant

Apply sealant in accordance with sealant manufacturer's instructions with gun having nozzle that fits joint width. Do not use sealant that has

exceeded shelf life or can not be discharged in a continuous flow. Completely fill the joint solidly with sealant without air pockets so that full contact is made with both sides of the joint. Tool sealant with a round instrument that provides a concave profile and a uniformly smooth and wrinkle free sealant surface. Do not wet tool the joint with soap, water, or any other liquid tooling aid. Do not apply sealant until all EFS coatings are fully dry. During inclement weather, protect the joints until sealant application. Use particular caution in sealing joints between window and door frames and the EFS wall and at all other wall penetrations. Clean all surfaces to remove excess sealant.

3.5 FIELD QUALITY CONTROL

Throughout the installation, the contractor shall establish and maintain an inspection procedure to assure compliance of the installed EFS with contract requirements. Work not in compliance shall be removed and replaced or corrected in an approved manner. The inspection procedures, from acceptance of deliveries through installation of sealants and final acceptance shall be performed by qualified inspector trained by the manufacturer. No work on the EFS shall be performed unless the inspector is present at the job site.

3.5.1 Third Party Inspection

Provide full time third party inspection during the entire process of installing the EFS, from examination through cleanup. The third party inspector shall be certified by the Exterior Design Institute (EDI) or by an equivalent independent party and shall be trained in the proper installation of EFS.

3.5.2 Inspection Check List

During the installation and at the completion of installation, perform inspections covering at the minimum all applicable items enumerated on the attached check list. The inspector shall initial and date all applicable items, sign the check list, and submit it to the Contracting Officer at the completion of the EFS erection.

CHECK LIST

<u>Item</u>	<u>Description</u>	<u>Appr'd/Date</u>
a.	Materials are handled and stored correctly.	=====
b.	Environmental conditions are within specified limits, including temperature not below 4 degrees C (40 degrees F), and the work is protected from the elements as required.	=====
c.	Preparation and installation is performed by qualified personnel using the correct tools.	=====
d.	Adjacent areas to which EFS is not to be applied (such as on window and door frames) are protected with masking tape, plastic films, drop cloths, etc. to prevent accidental application of EIFS materials.	=====
e.	Control, expansion and aesthetic joints are installed as indicated or recommended. Accessories are properly installed.	=====
f.	Substrate is in-plane, properly attached, clean, dry, and free of contaminants. Concrete substrate is free of efflorescence.	=====
g.	Materials are mixed thoroughly and in proper proportions.	=====
h.	Adhesive is applied in sufficient quantity with proper-size notched trowel.	=====
i.	Mechanical attachments have proper spacing, layout and fastener depth.	=====
j.	Reinforcing fabric mesh is properly back-wrapped at terminations.	=====
k.	Reinforcing fabric mesh is fully embedded and properly placed. Corners are reinforced. Openings are diagonally reinforced. Mesh overlaps minimum 65 mm (2-1/2 inches).	=====
l.	Base coat thickness is within specified limits.	=====
m.	The base coat/reinforcing fabric mesh must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	=====
n.	Finish coat is applied with sufficient number of personnel and stopped at suitable points. Floats and methods of texturing are uniform.	=====

CHECK LIST

<u>Item</u>	<u>Description</u>	<u>Appr'd/Date</u>
o.	All Flashings are properly installed.	=====
p.	All joints are properly sealed in their entire length at time and under environmental conditions as specified by the manufacturer.	=====
q.	All scaffolding, equipment, materials, debris and temporary protection are removed from site upon completion.	=====

Name of Inspector:_____ Signed:_____ Date:_____

3.6 CLEANUP

Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of EFS.

-- End of Section --

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SECTION 07416A

STANDING SEAM METAL ROOF (SSMR) SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISI SG-673	(1986) Cold-Formed Steel Design Manual
AISC PC 89/22	(1994) Stainless and Heat Resisting Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1988) Stainless and Heat Resisting Chromium - Nickel Steel Plate Sheet and Strip
ASTM A 463/A 463M	(2000) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive

Environments

ASTM D 1970	(2001) Self-Adhering Polymer Modified Bitumen Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1999) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993; R 1999e1) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(2001) Fluorescent UV-Condensation Exposures of Related Coatings
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 610	(1995) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(1987; R 1994e1) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(1998) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 96	(2000) Water Vapor Transmission of Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures
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1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

1.2.1 Standing Seam Metal Roof (SSMR) System

The SSMR system covered under this specification shall include the entire roofing system; the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system.

1.2.2 Manufacturer

The SSMR system shall be the product of a manufacturer who has been in the practice of manufacturing and designing SSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.2.3 Installer

The installer shall be certified by the SSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

1.3 DESIGN REQUIREMENTS

The design of the SSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Modification to details indicated on the drawings shall be permitted to be made by the manufacturer of the SSMR System and to meet Warranty Requirements and to insure a weathertight construction. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.3.1 Design Criteria

Design criteria shall be in accordance with ASCE 7, unless otherwise specified.

1.3.2 Thermal Loads

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of 40 degrees C during the life of the structure.

1.3.3 Roof Panels Design

Steel panels shall be designed in accordance with AISI SG-673. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load or wind load shall not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

1.3.4 Accessories and Their Fasteners

Accessories and their fasteners shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Standing Seam Metal Roof System; G.

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSMR system shop drawings shall be provided by the metal roofing manufacturer.

SD-03 Product Data

Design Analysis; G.

Design analysis signed by a Registered Professional Engineer employed by the SSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system (when provided by the Contractor), roofing system and its components; valley designs, gutter/downspout calculations, screw pullout test results, and shall indicate how expected thermal movements are accommodated.

Qualifications.

Qualifications of the manufacturer and installer.

SD-04 Samples

Accessories.

One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels.

One piece of each type to be used, 225 mm long, full width.

Factory Color Finish.

Three 75 by 125 mm samples of each type and color.

Fasteners.

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation.

One piece, 300 by 300 mm, of each type and thickness to be used, with a label indicating the rated permeance (if faced) and R-values. The flame spread, and smoke developed rating shall be shown on the label or provided in a letter of certification.

Gaskets and Insulating Compounds.

Two samples of each type to be used and descriptive data.

Sealant.

One sample, approximately 0.5 kg, and descriptive data.

Concealed Anchor Clips.

Two samples of each type used.

Subpurlins.

One piece, 225 mm long.

EPDM Rubber Boots.

One piece of each type.

SD-06 Test Reports

The report shall include the following information:

- a. Details of the SSMR system showing the roof panel cross-section with dimensions and thickness.
- b. Details of the anchor clip, dimensions, and thickness.
- c. Type of fasteners, size, and the number required for each connection.
- d. Purlins/subpurlins size and spacing used in the test.
- e. Description of the seaming operation including equipment used.
- f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.
- g. Any additional information required to identify the SSMR system tested.
- h. Signature and seal of an independent registered engineer who witnessed the test.

SD-07 Certificates

Standing Seam Metal Roof System.

- a. Certification that the actual thickness of uncoated sheets used in SSMRS components including roofing panels, subpurlins, and concealed anchor clips complies with specified requirements.
- b. Certification that materials used in the installation are mill certified.
- c. Previous certification of SSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.
- d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.
- e. Certification of installer. Installer certification shall be furnished.

f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Standing Seam Metal Roof (SSMR) System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranties, and the manufacturer's 20-year system weathertightness warranty.

Insulation.

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

1.6 WARRANTIES

The SSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.6.1 Contractor's Weathertightness Warranty

The SSMR system shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified thermal loads, and water leaks. The SSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, and curbs; exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of these specifications that are part of the SSMR system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified thermal loads, water leaks shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects.

This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR STANDING SEAM METAL ROOF (SSMR) SYSTEM, and shall start upon final acceptance of the facility. It is

required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire SSMR system as outlined above.

1.6.2 Manufacturer's Material Warranties.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (ΔE) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

c. A roofing system manufacturer's 20 year, non-prorated, system weathertightness warranty.

1.7 COORDINATION MEETING

A coordination meeting shall be held 30 days prior to the first submittal, for mutual understanding of the Standing Seam Metal Roof (SSMR) System contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roof system manufacturer, the roofing supplier, the erector, the SSMR design engineer of record, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

PART 2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 9 m. When length of run exceeds 9 m and panel laps are provided, each sheet in the run shall extend over three or more supports. Sheets longer than 30 m may be furnished if

approved by the Contracting Officer. Width of sheets shall provide not more than 600 mm of coverage in place. SSMR system with roofing panels greater than 300 mm in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 38 mm for rolled seam and 38 mm.

2.1.1 Steel Panels

Steel panels shall be zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Zinc, zinc-aluminum alloy or aluminum coated panels shall be 0.584 mm thick minimum. Panels shall be within 95 percent of reported tested thickness.

2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be type 316 stainless steel, conforming to AISC PC 89/22, ASTM A 167. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live loads.

2.3 ACCESSORIES

Accessories shall be compatible with the covering furnished. Flashing, gutters, downspouts, trim, metal closure strips, caps and similar metal accessories shall not be less than the minimum thickness specified for roofing panels and shall be as specified under Section 07600a SHEET METALWORK, GENERAL. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

2.4 FASTENERS

All fasteners shall be type 316 stainless steel, conforming to AISC PC 89/22, ASTM A 167 or other corrosive resisting steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners shall be the manufacturer's standard. Exposed roof fasteners shall be sealed or have sealed washers on the exterior side of the roof to waterproof the fastener penetration. Washer material shall be compatible with the roofing and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3 mm thick. Exposed fasteners for factory color finished panels shall be factory finished to match the color of the panels.

2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Actual screw pull out test results shall be performed for the actual material gage

and yield strength of the structural purlins or subpurlins to which the clip is to be anchored/attached. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 Bolts

Bolts shall be not less than 6 mm diameter, shouldered or plain shank as required, with locking washers and nuts.

2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 6 mm diameter. Blind (pop) rivets shall be not less than 7 mm minimum diameter.

2.5 SUBPURLINS

Cold formed supporting structural members/subpurlins shall have a minimum thickness of 1.5 mm and a minimum tensile yield strength of 345 MPa. Hot rolled structural members shall have a minimum thickness of 6 mm and a minimum tensile yield strength of 248 MPa. Subpurlins shall be galvanized.

2.6 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 0.050 mm thickness consisting of a topcoat of not less than 0.018 mm dry film thickness and the paint manufacturer's recommended primer of not less than 0.025 mm thickness. The interior color finish shall consist of a backer coat with a dry film thickness of 0.013 mm. The exterior color finish shall meet the test requirements specified below.

2.6.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610; and a rating of 6, over 2.0 to 3.0 mm failure at scribe, as determined by ASTM D 1654.

2.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B or D for 1000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of

the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

2.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 13 mm diameter hemispherical head indenter, equal to 6.7 times the metal thickness in mm, expressed in Newton-meters, with no cracking.

2.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.6.7 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.7 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory. Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.7.1 Composite Rigid Board Insulation for Use Above a Roof Deck

Composite Rigid Board Insulation shall be polyisocyanurate faced with a

perlite insulation conforming to ASTM C 1289 Type III.

2.8 FASTENERS

Insulation manufacturer's recommendations for no less than required under ASCE 7. Fasteners for steel or concrete decks shall conform to FM P7825C for Class I roof deck construction and shall be spaced to withstand an uplift pressure of 2.87 KPa (60 psf) at 1-story and 2-story's and 4.3 KPa (90 psf) at buildings over 2-stories in height.

2.9 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.10 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.11 VAPOR RETARDER

2.11.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 1.15 ng per Pa-second-square meter or less when tested in accordance with ASTM E 96. Facing shall be white reinforced polypropylene kraft laminate (PSK). Facings and finishes shall be factory applied.

2.11.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to ASTM D 4397. A single ply of 0.25 mm polyethylene sheet; or, at the Contractor's option, a double ply of 0.15 mm polyethylene sheet shall be used. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.11.3 Slip Sheet for Use With Vapor Retarder

Slip sheet for use with vapor retarder shall be a 0.24 kg per square meter rosin-sized, unsaturated building paper.

2.12 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conform to the

contours of the roof panel to form a weather-tight seal.

2.13 PREFABRICATED CURBS AND EQUIPMENT SUPPORTS

Prefabricated curbs and equipment supports shall be of structural quality, hot-dipped galvanized or galvanized sheet steel, factory primed and prepared for painting with mitered and welded joints. Integral base plates and water diverter crickets shall be provided. Minimum height of curb shall be 200 mm above finish roof. Curbs shall be constructed to match roof slope and to provide a level top surface for mounting of equipment. Curb flange shall be constructed to match configuration of roof panels. Curb size shall be coordinated, prior to curb fabrication, with the mechanical equipment to be supported. Strength requirements for equipment supports shall be coordinated to include all anticipated loads. Flashings shall not be rigidly attached to underline structure.

2.14 VALLEY LINER

Valley liner material shall be a self-adhering modified bitumen membrane conforming to ASTM D 1970.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun prior to starting installation and periodically thereafter to assure it is adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Field Forming of Panels for Unique Area

When roofing panels are formed from factory-color-finished steel coils at the project site, the same care and quality control measures that are taken in shop forming of roofing panels shall be observed. Rollformer shall be operated by the metal roofing manufacturer's representative. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.2 Subpurlins (see purlins)

Unless otherwise shown, subpurlins shall be anchored to the purlins or other structural framing members with bolts or screws. Attachment to the substrate (when provided) or to the panels is not permitted. The subpurlin spacing shall not exceed 750 mm on centers at the corner, edge and ridge zones, and 1500 mm maximum on centers for the remainder of the roof. Corner, edge, and ridge zones are as defined in ASCE 7.

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, roof curbs, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation. Expansion joints for the standing seam roof system shall be installed at locations indicated on the contract drawings and other locations indicated on the manufacturer's drawings. Fascia panels shall be fixed at top edge to preclude sliding out of concealed clip fasteners.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members unless otherwise indicated. Attachment to the substrate (when provided) or to the metal deck is not permitted. The maximum distance, parallel to the seams, between clips shall be 750 mm on center at the corner, edge, and ridge zones, and 1500 mm maximum on centers for the remainder of the roof.

Clips for securing metal valley flashing shall be 50 mm (2 inches) wide with 2 fasteners set side by side per clip. The back tab of the valley flashing clip shall be bent over the fastener heads and the tab hammered flat or keep the fastener heads from damaging the underside of roof panels, as detailed on the drawings.

3.1.5 Concealed Anchor Clips and Bearing Plates

Concealed anchor clips and bearing plates shall be fastened through the roof insulation to the steel deck. Fastener length shall be determined by thickness of the insulation plus depth of the steel deck. Fasteners shall extend 5/8 inch below the steel deck. The maximum distance, between clips shall be 750 mm on center for the entire roof.

3.2 INSULATION INSTALLATION

Insulation shall be continuous over entire roof surface between subpurlins as indicated on the drawings. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation with vapor retarder providing equivalent R-value and perm rating as remaining insulation. Insulation shall be installed as indicated and in

accordance with manufacturer's instructions.

3.2.1 Board Insulation

Rigid board insulation shall be laid in close contact. Board shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other, and shall have a minimum of 1 fastener per 0.37 square meters. Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

A cloth industrial duct tape shall be applied over the seams of metal roof decks, at penetration edges, and at surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decks, cloth industrial duct tape shall be applied over irregularities which could potentially puncture polyethylene membrane.

3.4 VAPOR RETARDER INSTALLATION

3.4.1 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.5 SLIP SHEET INSTALLATION

A slip sheet shall be laid over the blanket insulation facing to prevent the vinyl facing from adhering to the metal roofing.

3.6 CLEANING AND TOUCH-UP

Exposed SSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF (SSMR) SYSTEM

FACILITY DESCRIPTION _____

BUILDING NUMBER: _____

CORPS OF ENGINEERS CONTRACT NUMBER: _____

CONTRACTOR

CONTRACTOR: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

OWNER

OWNER: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONSTRUCTION AGENT

CONSTRUCTION AGENT: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF (SSMR) SYSTEM
(continued)

THE SSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE SSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH ASTM E 1592. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE SSMR SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE SSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF (SSMR) SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE SSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE SSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE SSMR SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF (SSMR) SYSTEM
(continued)

**REPORTS OF LEAKS AND SSMR SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSMR SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSMR SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

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SECTION 07600A

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SECTION 07600A

SHEET METALWORK, GENERAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1784 (1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 226 (1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D 3656 (1997) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual (1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Sheet metal associated with metal roofing including gutters and downspouts shall be fabricated from the same pre-finished materials provided under Section 07416a, SEAM METAL ROOF (SMR) SYSTEM. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in DIVISION 15 - MECHANICAL.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal.

2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

2.1.2 Sheet Metal

All sheet metal for flashings, gutters, downspout leaders, etc. shall be provided from the same source in the same finish as roof materials provided under Section 07416a, STANDING SEAM METAL ROOF (SSMR) SYSTEM.

2.1.3 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900a JOINT SEALING.

2.1.4 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

2.1.5 Felt

ASTM D 226, Type I.

2.1.6 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 1.9 mm minimum thickness.

2.1.7 Louver Screen

Type III aluminum alloy insect screening conforming to ISWA IWS 089 conforming to ASTM D 3656.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Gutters and downspouts shall be designed and fabricated in conformance with SMACNA Arch. Manual; louvers shall be fabricated in conformance with SMACNA Arch. Manual and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm (1/2 inch) hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips.

3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA Arch. Manual. Expansion joints in continuous sheet metal shall be provided at 12.0 meter intervals spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.3 CONNECTIONS AND JOINTING

3.3.1 Seaming

Flat-lock seams shall finish not less than 25 mm wide. Unsoldered plain-lap seams shall lap not less than 75 mm unless otherwise specified. Flat seams shall be made in the direction of the flow.

3.4 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.5 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be installed as indicated. Gutters shall be supported by cleats spaced not less than 915 mm (36 inches) apart. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.6 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations.

Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

3.6.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 75 mm on centers. Metal base flashing shall not be used on built-up roofing.

3.6.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown on the drawings. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.6.3 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.6.4 Valley Flashing

Valley flashing shall be installed as specified in SMACNA Arch. Manual and as indicated.

3.7 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as

indicated.

3.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

TABLE 1. SHEET METAL WEIGHTS AND THICKNESS

<u>Item Description</u>	<u>Factory-color Finish steel, mm (inch),</u>	<u>Copper clad Stainless steel, inch</u>
Cleats (Continuous)	.61 mm (0.024")*	--
Downspouts, heads and leaders	.61 mm (0.024")*	--
Downspout brackets	.318 x 25 mm (1/8" x 1"	--
Flashing	.61 mm (0.024")*	--
Gutters (girth)	.61 mm (0.024")*	--
Gutters brackets	.318 mm x 38.1 mm (1/8" x 1-1/2")	--
Gutter cleats	.61 mm (0.024")*	--
Strainers (wire gauge)	-----	No. 12

* Thickness factory-color finished steel shall not be less than the minimum thickness for standing seam metal roof panels.

TABLE 2. SHEET METAL JOINTS

<u>Item</u> <u>Designation</u>	<u>Type of Joint</u>		<u>Remarks</u>
	<u>Factory color-finished</u>	<u>Aluminum</u>	
Cleats (Continuous)	Butt	-----	-----
Flashings:	25.4 mm (1-inch), flat locked, and sealed with sealant D or F as specified in Section 07900a, JOINT SEALING.	-----	-----
Gutters	38.1 mm (1-1/2 inch) lap, riveted and and sealed with sealant D and F as specified in Section 07900a, JOINT SEALING.	-----	-----

-- End of Section --

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DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07810

SPRAY-APPLIED FIREPROOFING

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SECTION 07810

SPRAY-APPLIED FIREPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 1042	(1992; R 1997e1) Acoustically Absorptive Materials Applied by Trowel or Spray
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 605	(1993; R 1996) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 759	(1992; R 1996) Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 760	(1992; R 1996e1) Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 761	(1992) Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 937	(1993) Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

UNDERWRITERS LABORATORIES (UL)

UL 263	(1997; Rev thru Jun 1998) Fire Tests of
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Building Construction and Materials

UL Fire Resist Dir

(1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fireproofing Material; G

Data identifying performance characteristics of fireproofing material. Data shall include recommended application requirements and indicate thickness of fireproofing that must be applied to achieve each required fire rating.

SD-04 Samples

Spray-Applied Fireproofing; G

One sample panel, 450 mm square, for each specified type of fireproofing. Also, a designated sample area of not less than 9 square meters shall be prepared. Sample area shall be representative of typical installation of fireproofing including metal decks, beams and attachments. Equipment, materials and procedures used in the sample area shall be the same as, or representative of, that to be used in the work. The sample area shall be approved prior to proceeding with fireproofing work in any other area. The approved sample area shall be used as a reference standard for applied fireproofing material. Sample area shall remain in place and open to observation until all spray-applied fireproofing is completed and accepted, at which time it may become part of the work.

SD-06 Test Reports

Fire Resistance Rating; G

Reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method.

Field Tests; G

Test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required.

SD-07 Certificates

Installer Qualifications; G

Manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing.

Surface Preparation Report; G

Manufacturer's certification that surfaces to be protected have been inspected and are acceptable to receive spray-applied fireproofing. The statement shall list the structural members and the areas that have been inspected and certified.

Manufacturer's Inspection Report; G

Manufacturer's certification that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.

1.3 DELIVERY AND STORAGE

Packaged material shall be delivered in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Fireproofing material shall be kept dry until ready to be used, and shall be stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Material with shelf-life shall be applied prior to expiration of the shelf-life.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Substrate and ambient air temperatures shall be maintained above 4 degrees C during application and for 24 hours before and after application. Relative humidity shall be maintained within the limits recommended by the fireproofing manufacturer.

1.4.2 Ventilation

Adequate ventilation shall be provided to properly dry the fireproofing after application. In enclosed areas, a minimum of 4 air exchanges per hour shall be provided by forced air circulation.

1.5 INSTALLER QUALIFICATIONS

Engage an experienced installer that is certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. Each installer of fireproofing material shall be trained, have a minimum of 3 years experience and a

minimum of three installations using fireproofing of the type specified. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

1.6 MANUFACTURER'S SERVICES

The manufacturer or its representative shall be onsite prior to, periodically during, and at completion of the application, to provide the specified inspections and certifications; and to ensure that preparations are adequate and that the material is applied according to manufacturer's recommendations and the contract requirements.

1.7 FIRE RESISTANCE RATING

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resist Dir. Proposed materials not listed in UL Fire Resist Dir shall have fire resistance ratings at least equal to the UL Fire Resist Dir ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E 119. Fireproofing shall be applied to structural steel members. Use unrestrained fire resistance ratings, unless the architect/engineer has specified that the degree of thermal restraint of the construction meets or exceeds the degree of thermal restraint of the tested assembly. Performance tests shall be in accordance with ASTM E 119.

1.8 EXTENT OF FIREPROOFING

All structural steel and steel roof decks (if required) shall be protected with spray-applied fireproofing to a fire resistance hour-rating as indicated in the preceding paragraph, unless otherwise indicated.

1.9 PRE-INSTALLATION CONFERENCE

The Contractor shall hold a meeting with the installer, field testing agency, the manufacturer, subcontractors (whose employees come into contact with the fireproofing), and the Contracting Officer prior to the installation of any fireproofing material to review the substrates for acceptability, method of application, applied thickness, patching, repair, inspection and testing procedures.

PART 2 PRODUCTS

2.1 SPRAY-APPLIED FIREPROOFING

Spray-applied fireproofing material, including sealer, shall conform to ASTM E 1042, Class (a), Category A, either Type I or Type II, except that the dust removed shall not exceed 0.027 gram per square meter of fireproofing material applied as specified in the project. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G 21.

2.1.1 Dry Density and Cohesion/Adhesion

Fireproofing shall have a minimum ASTM E 605 dry density and ASTM E 736

cohesion/adhesion properties as follows:

2.1.1.1 Concealed Structural Components

Fireproofing for structural components concealed above the ceiling shall have a minimum average applied dry density of 240 kg per cubic meter and a cohesion/adhesion strength of 9.57 kPa (200 psf) .

2.1.1.2 Exposed Structural Components

Fireproofing for exposed structural components, except where otherwise specified or indicated, shall have a minimum applied dry density of 350 kg per cubic meter and a cohesion/adhesion strength of 20.83 kPa .

2.1.1.3 Mechanical Rooms and Storage Areas

Fireproofing for structural components located in mechanical rooms and storage areas shall have a minimum applied dry density of 640 kg per cubic meter and a cohesion/adhesion strength of 19.15 kPa .

2.1.2 Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when backing to which it is applied is subject to downward deflection 1/120 of 3 m clear span, when tested in accordance with ASTM E 759.

2.1.3 Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E 760.

2.1.4 Compressive Strength

The minimum compressive strength shall be 48 kPa when tested in accordance with ASTM E 761.

2.1.5 Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E 937.

2.2 SEALER

Sealer shall be the type approved by the manufacturer of the fireproofing material, shall be fungus resistant and shall be white color.

2.3 WATER

Water used for material mixing and surface preparation shall be potable.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be fireproofed shall be thoroughly cleaned of dirt, grease, oil, paint, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be coordinated with the manufacturer and detailed in submittal item SD-01 Data.

3.2 PROTECTION

Surfaces not to receive spray-applied fireproofing shall be covered to prevent contamination by splatter, rebound and overspray. Exterior openings in areas to receive spray-applied fireproofing shall be covered prior to and during application of fireproofing with tarpaulins or other approved material. Surfaces not to receive fireproofing shall be cleaned of fireproofing and sealer.

3.3 MIXING

Fireproofing material shall be mixed in accordance with the manufacturer's recommendations.

3.4 APPLICATION

3.4.1 Sequence

Prior to application of fireproofing, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. Fireproofing shall be applied to underside of steel roof deck assemblies, only after respective roof construction is complete. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing. The contractor shall not allow roof traffic during application and curing period.

3.4.2 Application Technique

Water pressure and volume shall be maintained to manufacturer's recommendations throughout the fireproofing application. Fireproofing material shall be applied to the thickness and density established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Fireproofing material shall not be tamped to achieve the desired density.

3.4.3 Sealer Application

If sealer is required by the product used, it shall be applied after field testing has been conducted and after corrective measures and repairs, if required, have been completed.

3.4.4 Applied Thickness

The minimum average thickness shall be no less than 9.525 mm . Thicknesses shall not be less than required to achieve designated fire resistance ratings. If the specified thickness is greater than or equal to 25 mm , any individual measurement shall not be less than the specified thickness minus 6 mm . If the specified thickness is less than 25 mm , any individual measurement shall not be less than the specified thickness minus 25 percent.

3.5 FIELD TESTS

The applied fireproofing shall be tested by an approved independent testing laboratory, in approved locations, for density, cohesion/adhesion force as specified, and for thickness in accordance with ASTM E 605. Two sets of tests shall be conducted on 930 square meter area, whichever is less, at the approved locations. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

3.5.1 Thickness, Density, Cohesion/Adhesion

Each structural component type shall be tested at roof decks, beams, joists, and trusses. Minimum average thickness shall be as required by UL Fire Resist Dir. Density and cohesion/adhesion shall be as specified.

3.5.2 Repair

Additional fireproofing material may be added to provide proper thickness. Rejected areas of fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied or patching materials recommended by the manufacturer. Repaired areas shall be retested and reinspected. Fireproofing material shall be applied to voids or damaged areas by hand-trowel, or by respraying.

3.5.3 Manufacturer's Inspection

The manufacturer shall inspect the fireproofing work after the work is completed on area, including testing, repair and clean-up, and shall certify that the work complies with the manufacturer's criteria and recommendations. Before the sprayed material is covered, and after all of the fireproofing work is completed, including repair, testing, and clean-up; and after mechanical, electrical and other work in contact with fireproofing material has been completed, the manufacturer shall re-inspect the work and certify that the entire project complies with the manufacturer's criteria and recommendations. The Contractor shall obtain and submit the Manufacturer's Inspection Report and certifications of approval.

3.5.4 Patching

Patching and repairing of damaged fireproofing is the responsibility of the Contractor. The patching material shall be the same as that specified for that area.

3.6 CLEANUP

Surfaces not indicated to receive fireproofing shall be thoroughly cleaned of sprayed material within a 24 hour period after application.

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SECTION 07840A

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SECTION 07840A

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 814	(2002) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Feb 1998) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(2003) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

SD-07 Certificates

Firestopping Materials

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications

Documentation of training and experience.

Inspection

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating

than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

- a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

- d. Construction joints in floors and fire rated walls and partitions.
- e. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

3.4 FIRESTOPPING ID PLATE

Firestopping ID plate: A permanent wall identification plate (WID) and a pipe tag are required to be permanently mounted adjacent to every fire barrier penetration on both sides of the wall or floor. The WID plate shall be minimum 4" X 3"(102mm X 77 mm) in size and the pipe tag shall be minimum 1.5" X 1.5"(38mm X 38mm) in size, have raised letters & constructed of 20 gage minimum corrosion proof metal. In the event there are multiple pipe penetrations with the same firestopping system, a single wall ID plate can be used if each pipe penetration is listed on the WID plate separated with commas and each pipe is identified with a pipe tag. Shop drawings to be submitted for approval. All WID and pipe tags to be submitted for approval prior to installation. The wall ID plate shall contain the following:

___hr Fire Barrier Penetration
 Pipe # _____
 UL System # _____
 Description: _____

 F rating: _____hr
 T rating: _____hr
 Wall/Floor Material: _____
 Sealant ID _____
 Manufacturer _____
 Certified Installer:
 Name: _____
 Address: _____

Installation Date: _____

Example:

1 hr Fire Barrier Penetration
 Pipe # _1, 2, 5_
 UL System # _WL2078_
 Description: _Plastic pipe thru 1 hr
gypsum wall_
 F rating: _1_hr
 T rating: _1_hr
 Wall/Floor Material: Gypsum wall
 Sealant ID: Hilti CP 642_
 Manufacturer _Hilti_
 Certified Installer:
 Name: Mr Chester Yamamoto_
 Company: Firestopping Inc.
 Address: 1920 Ala Moana Blvd_
Honolulu, HI 96818_
 Installation Date: 30 June 2003_

The pipe tag shall contain the following:

Pipe # _____
 Insulated: _____
 Pipe Material: _____
 Pipe Size: _____
 Use: _____

Example:

Pipe # 5_
 Insulated: No
 Pipe Material: CPVC
 Pipe Size: _4"_____
 Use: domestic CW

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SECTION 07900A

JOINT SEALING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	(1993) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 217	(1997) Cone Penetration of Lubricating Grease (IP50/88)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Backing.

Bond-Breaker.

Sealant.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-07 Certificates

Sealant.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits not exceeding 32 degrees C when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures not exceeding 32 degrees C unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A, Grade 2A3, round cross section.

2.1.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods.

2.1.3 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2A3.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 SEALANT

2.4.1 LATEX

Latex Sealant shall be ASTM C 834.

2.4.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polysulfide Sealant B for joints at perimeter of doors and windows: Type S, Grade NS, Class 25, Use NT, M, G, A, O.
- b. Polyurethane sealant C for horizontal joints subject to traffic: Type M, Grade P, Class 25, Use T, M, O.
- c. Polyurethane Sealant D for vertical and horizontal non-traffic joints: Type M, Grade NS, Class 25, Use NT, M, G, A, O.
- d. Polyurethane Sealant E for Sheet Metal Flashing: Type S or M, Grade NS, Class 25, Use NT, M, G, A, O, or use sealant D.
- e. Silicone sealant F for Bathtubs, Showers, Countertops and Glazing: Type S, Grade NS, Class 25, Use NT, M, G, A, O.

2.4.3 ACOUSTICAL

Rubber or polymer-based acoustical sealant shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining.

2.4.4 PREFORMED

Preformed sealant H shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C, the sealant shall be non-bleeding and shall have no loss of adhesion.

2.4.4.1 Tape

Tape sealant J: cross-section dimensions shall be 19 mm (3/4 inch).

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant.

Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant

smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

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SECTION 08110

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI A250.6 (1997) Hardware on Standard Steel Doors
(Reinforcement - Application)
- ANSI A250.8 (1998) SDI-100 Recommended Specifications
for Standard Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process
- ASTM A 924/A 924M (1999) General Requirements for Steel
Sheet, Metallic-Coated by the Hot-Dip
Process

DOOR AND HARDWARE INSTITUTE (DHI)

- DHI A115 (1991) Steel Door Preparation Standards
(Consisting of A115.1 through A115.6 and
A115.12 through A115.18)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 80 (1999) Fire Doors and Fire Windows
- NFPA 252 (1999) Standard Methods of Fire Tests of
Door Assemblies

STEEL DOOR INSTITUTE (SDOI)

- SDI 105 (1998) Recommended Erection Instructions
for Steel Frames

SDI 111-B Recommended Standard Details for Dutch
Doors

SDI 111-C Recommended Louver Details for Standard
Steel Doors

UNDERWRITERS LABORATORIES (UL)

UL 10B (1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and

data sufficient for comparison to ANSI A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710 DOOR HARDWARE. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated.

2.1.1 Standard Duty Doors

ANSI A250.8, Level 1, physical performance Level c, Model 1, of size(s) and design(s) indicated and core construction as required by the manufacturer. Provide where shown.

2.2 ACCESSORIES

2.2.1 Shelves for Dutch Doors

SDI 111-B. Fabricate shelves of steel not lighter than 1.5 mm thick, 200 mm wide. Brackets shall be stock type fabricated of the same metal used to fabricate shelves.

2.2.2 Louvers

2.2.2.1 Interior Louvers

SDI 111-C, Louvers shall be stationary sightproof type where scheduled. Detachable moldings on room or non security side of door; moldings to be integral part of louver. Form louver frames of 0.9 mm thick steel and louver blades of a minimum 0.6 mm. Louvers for lightproof doors shall have minimum of 20 percent net-free opening.

2.2.3 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, provide overlapping steel astragals with the doors, as indicated. For interior pairs of fire rated doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies.

2.2.4 Moldings

Provide moldings around glass of interior doors and louvers of interior doors. Provide nonremovable moldings on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings.

2.3 STANDARD STEEL FRAMES

ANSI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, interior glazed panels, unless otherwise indicated.

2.3.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.3.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.3.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

2.3.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.3.3.2 Floor Anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member.

2.4 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

2.4.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.4.2 Astragal on Fire Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.

2.5 WEATHERSTRIPPING

2.5.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals as specified in hardware sets. Insert gasket in groove after frame is finish painted.

2.6 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to DHI A115.

Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.7 FINISHES

2.7.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8. Where coating is removed by welding, apply touchup of factory primer.

2.7.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior and interior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum

requirements for coatings having 122 grams per square meter, total both sides, i.e., ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8. Provide for exterior doors and interior doors.

2.8 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.8.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean

thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

<u>PRODUCTS</u>	<u>INCH-POUND</u>	<u>METRIC</u>
Door thickness	1 3/4 inches	44.5 mm
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	16 gage	1.5 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
Anchor bolts	3/8 inches	10 mm

-- End of Section --

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SECTION 08210

WOOD DOORS

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SECTION 08210

WOOD DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Fire Windows
 NFPA 252 (1995) Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

NWWDA I.S. 1-A (1993) Architectural Wood Flush Doors
 NWWDA TM-5 (1990) Split Resistance Test
 NWWDA TM-7 (1990) Cycle - Slam Test
 NWWDA TM-8 (1990) Hinge Loading Resistance Test

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing.

SD-03 Product Data

Doors; G

Accessories

Water-resistant sealer

Sample warranty

Fire resistance rating; G

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

Door finish colors; G

Submit a minimum of three color selection for selection by the Contracting Officer.

SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with NWWDA TM-5, cycle-slam test report for doors tested in accordance with NWWDA TM-7, and hinge loading resistance test report for doors tested in accordance with NWWDA TM-8.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated.

2.1.1 Flush Doors

Flush doors shall conform to NWWDA I.S. 1-A. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

2.1.2 Core Construction

2.1.2.1 Solid Cores

Door construction shall be glued wood block core or particle board core or mineral core with vertical and horizontal edges bonded to the core. Blocking and hardware reinforcements for particle board and mineral core doors shall be blocking option HB-1-5 or HB-2-5 in accordance with NWWDA I.S. 1-A.

2.2.2 Face Panels

2.1.3 Natural Finished Wood Veneer Doors

Veneer doors to receive natural finish shall be Custom Grade red oak or white oak or cherry veneer as indicated and shall be in accordance with NWWDA I.S. 1-A. Vertical stile strips shall be selected to provide edges of the same species and/or color as the face veneer. Door finish shall be in accordance with paragraph FIELD FINISHING.

2.2 FIRE RATED DOORS

Fire rated door assemblies shall bear the listing identification label of a nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. The specific time interval rating on the labels shall be as shown. Door assemblies shall be in accordance with NFPA 80. Listing identification on labels shall be constructed and permanently applied by a method which results in their destruction should they be removed. Fire rated doors shall be mineral core, particleboard core or staved lumber core 20 minute rating. As an alternative in lieu of such label, the fire doors, hardware and accessories shall bear the label of a nationally recognized testing agency, adequately equipped and competent to perform services equivalent to the inspection and certificate programs of the Underwriters' Laboratories, Inc., indicating that the units conform to the requirements of the Underwriters' Laboratories, Inc. Where design requirements in the contract documents interfere with the labeling of fire doors, the door will be modified to conform to the design and construction requirements of fire doors labeled by the U.L.

2.2.1 Reinforcement Blocking

Fire rated doors shall be provided, as required, with hardware reinforcement blocking, and top, bottom, and intermediate rail blocking. Lock blocks shall be manufacturer's standard. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements. Reinforcement blocking shall not be of mineral material.

2.2.2 Stile Edges

Composite fire rated doors shall be provided with vertical stile edges that do not contain fire retardant salts. Vertical stiles shall be of the same species and/or color as the face veneer.

2.3 ACCESSORIES

2.3.1 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in Section 08810a GLASS AND GLAZING.

2.3.2 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Size of lock blocks shall be as required to secure the hardware specified. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

2.4 FABRICATION

2.4.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

2.4.2 Quality and Construction

Identify the standard on which the construction of the door was based, identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

2.4.3 Adhesives and Bonds

NWWDA I.S. 1-A. Use Type I bond for exterior doors for Lobby and Breezeway and Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

2.4.4 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

2.4.5 Finishes

2.4.5.1 Field Painting

Doors to receive field finishing, natural finish, shall be factory primed or sealed, as required, and then shall be finished in accordance with Section 09900 PAINTING, GENERAL. Factory applied sealer shall not prevent doors from accepting field stain and finish. Color shall be as indicated on the drawings. Field touch-up of factory finishes shall be in accordance with manufacturers instructions.

2.4.5.2 Color

Provide door finish colors as indicated.

2.4.6 Water-Resistant Sealer

Provide a water-resistant sealer compatible with the specified finishes as approved and as recommended by the door manufacturer.

2.5 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

- a. Split resistance: Average of ten test samples shall be not less than 225 kilograms load when tested in accordance with NWWDA TM-5.
- b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of NWWDA TM-7.
- c. Hinge loading resistance: Average of ten test samples shall be not less than 315 kilograms load when tested for direct screw withdrawal in accordance with NWWDA TM-8 using a No. 12, 30 mm long, steel, fully threaded wood screw. Drill 4 mm pilot hole, use 40 mm opening around screw for bearing surface, and engage screw full, except for last 3 mm. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 2 mm minimum, 3 mm maximum clearance at sides and top, and a 5 mm minimum, 6 mm maximum clearance over thresholds. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp shall not exceed 6 mm when measured in accordance with NWWDA I.S. 1-A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

3.1.2 Prehung Doors

Install doors in accordance with the manufacturer's instructions and details.

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SECTION 08580

BLAST RESISTANT WINDOWS FOR EXTERNAL ENVELOPE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603.8	Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum
AAMA/NWDA 101 I.S.2	(1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
AAMA 907	(1996) Voluntary Specification for Corrosion Resistant coatings on Carbon Steel Components
AAMA 800	(1992) Voluntary Specification and Test Methods for Sealants
AAMA 850	(1991) Fenestration Sealants Guide Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(1991; R1997) Flat Glass
ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 1300	(1998) Standard Practice for Determining Load Resistance of Glass in Buildings

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA-GM	(1997) Glazing Manual
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British Standards (BS)

BS 5889

(1989) Specification for One Part Gun
Grade Silicon Based Sealants.

1.2 GENERAL REQUIREMENTS

Provide and install window units as indicated on the drawings, including glazing, closure trim, stool, hardware, anchors, fasteners, and sub-frames required to install blast resistant punch and ribbon windows in the external envelope of the building, unless noted otherwise.

1.3 QUALIFICATIONS

The Contractor shall select a window manufacturer capable of providing required quality and quantities in accordance with the approved contract schedule.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows; G.

The drawing package shall be conventional shop drawings and shall indicate elevations of units, full-size sections depicting sight lines, type of materials, thicknesses of materials, glazing setting method, connections with other work including installation mechanisms and details, and window elevations showing location of each window unit. Include proposed method of anchoring, size and spacing of anchors, and details of construction.

SD-03 Product Data

Windows; G.
Glass; G.
Setting Materials; G.
Fasteners; G.
Accessories; G.
Subframe; G.
Hardware; G.

Data on windows consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, blast load rebound resistance ratings, windows, frames, anchors, hardware, and accessories. The data shall also include installation details and instructions for each type of window proposed.

Certification of system performance

The Contractor shall provide certification of the system performance for each type of window proposed. Certification may be demonstrated by either full scale testing in either an arena test or in a shocktube test or by detailed engineering analysis.

Certification by full-scale testing shall be performed by an independent testing entity standardly engaged in the performance of arena or shocktube testing. A minimum of three (3) specimens of each proposed window shall be tested. The Contractor shall submit a detailed test report signed by the test director that includes, as a minimum, the location and date of the tests, the name of the testing entity and test director, a full description of the specimens to be tested, temperature at time of test, reflected pressure history to which the test specimens were subjected, a description of the test specimen and any fragmentation produced immediately following the test, full pre-test and post-test photographic documentation of the specimens and witness area behind the specimens, and technical commentary by the test director on the rating achieved by each specimen.

Certification by detailed engineering analysis shall demonstrate the ability of each proposed window system to resist the blast loads shown on the drawings to the performance level specified in the paragraph "Structural Performance". The analysis shall include, as a minimum, the full response of the glazing, frame, sub-frame, operable mechanisms, mullions, and connections for the specified blast load. The analysis shall address all issues of shear, local buckling, web crippling. The analysis shall include a sketch of the blast waveform and dimensioned sketches of the each window component subject to analysis. The analysis for each proposed window system shall be certified by a Professional Engineer registered in the United States.

Window Units; G.

Submit delivery schedule with drawings indicating location of each window unit of each type, by floor, keyed into submittal elevations. All delivery milestones shall be referenced relative to the date that a notice to proceed is given to the awarded window vendor.

SD-04 Samples

Window units; G.

Submit one full-size window of each type proposed for use, complete with manufacturer's label, fastening anchors, and other accessories.

SD-07 Certificates

Window units; G.

Certificates shall state that all proposed windows units, including glazing, conform to the specified performance requirements. A certificate stating that window and frame provided was manufactured using the same materials, dimensions, and tolerances as the blast-resistance tested or analyzed prototype and listing the hardware and frame anchors required to achieve blast resistance shall be provided. An official authorized to certify on behalf of the manufacturer shall sign each certificate.

SD-09 Manufacturer's Field Reports

Minimum condensation resistance factor.
 Deflection.
 Air infiltration.
 Water penetration.
 Blast resistance test reports; G

Certified test reports or engineering analysis reports demonstrating blast resistance shall be submitted. Reports shall meet the requirements contained in paragraph SD-01 above.

SD-10 Operation and Maintenance Data

Window units; G.

1.5 DELIVERY, STORAGE AND PROTECTION

Contractor shall deliver windows in accordance with the approved project schedule. Contractor shall protect windows and associated materials in accordance with manufacturer's recommendations and shall replace with new, any windows damaged during Contractor delivery, Contractor storage or Contractor installation.

1.6 SYSTEM PERFORMANCE REQUIREMENTS AND TESTING

Provide window units that comply with performance requirements specified herein, as demonstrated by certified testing.

1.6.1 Air Infiltration

Provide units with an air infiltration rate, as defined in the test standard ASTM E 283, of not more than 0.10 CFM/minimum/per sq. ft. of wall area measured at a differential pressure across the assembly of 6.24 psf.

1.6.2 Water Penetration

Provide units with no water penetration, as defined in the test standard ASTM E 331, measured at a differential pressure across the assembly of 8.00 LBF per square foot.

1.6.3 Structural Performance

- a. Windows and frames shall be designed to withstand the blast

pressures shown on the structural drawings. Windows and connections shall comply with a minimum performance condition of 3B as defined in accordance with the GSA Security Design Criteria. The frame may deform, but shall not pull out of the wall or subframe. Glazing fragments shall fall between 1-meter of the interior face of the specimen and 0.5 meters or less above the floor of a vertical witness panel located 3 meters from the interior face of the specimen. There shall be 10 or fewer perforations in the area of a vertical witness panel located 3-meters from the interior face of the specimen and higher than 0.5 meters above the floor. None of the perforations shall penetrate through the full thickness of the witness panel.

The witness panel shall cover the entire back wall of the witness area and shall consist of 2-layers of material. The witness panel shall consist of a rear layer of 2.5-centimeter extruded Styrofoam with a density of 32.0 kilograms/meter³ (2 lbs./ft³), and a front layer consisting of 1.25-centimeter foil backed insulation board. The foil surface shall be placed toward the window glazing. To accommodate high-speed photography, a hole no greater than 10-centimeters by 10-centimeters may be made in either of the upper or lower 1/9th quadrants of the witness panel.

b. Blast tests, if used on a prototype window assembly, shall demonstrate that the window will resist the overpressure waveform at the performance specified. The overpressure waveform used in the test shall meet or exceed the design overpressure waveform in both peak overpressure and peak impulse. Blast tests will be accepted only if the window and frame proposed are manufactured using the same materials and methods as those in the prototype blast tests.

1.7 WARRANTY

Window units shall be provided with manufacturer's standard 10-year warranty from time of installation. Installation shall be performed by a certified installer and in conformance with manufacturer's warranty conditions.

1.8 QUALITY ASSURANCE

1.8.1 Standards

Comply with applicable recommended specification(s) of recognized national or international industry standards for window materials.

1.8.2 Prior Production History

Provide a description of the windows and glazing produced by the window manufacturer which shows prior production of units similar to those specified, in similar quality, quantity and schedule requirements.

1.8.3 Design Concepts

The project drawings indicate typical sizes, sight line, profiles and dimensional requirements of the required window types and are based upon

existing window sizes, sight lines, profiles and dimensions.

1.9 FIELD MEASUREMENTS

The Contractor shall field verify applicable existing conditions and dimensions as required for correct installation, and shall record field dimensions and quantities on the submitted shop drawings.

1.10 MOCK-UPS

Before fabrication, a full-size mock-up of each main type of window complete with glass and manufacturer's certification is required for the review of window construction and adherence to the guidelines set forth by the architect. The approval of mock-up shall establish the minimum standard of quality required for all windows. Mock-ups shall be in an actual opening and may be used as part of the work.

1.11 EXTRA MATERIALS

Provide a quantity of 10% additional windows, but not less than 1 additional window, including glazing, in unopened cartons.

PART 2 PRODUCTS

2.1 EXTERIOR WINDOWS

Windows shall be aluminum or steel and shall conform to the appropriate referenced standards or comparable approved standards. Windows and trim shall be of the type and size indicated and shall fully comply with the approved architectural drawings. Windows shall be cleaned, properly prepared, pre-treated, and coated with the specified finish. The Contractor shall coordinate all components of the window with applicable interior finishes, such that components are concealed from view and do not infringe into the interior of the adjacent spaces.

2.1.1 Windows

a. Construction: Windows shall be constructed per national or international industry standards for the window system proposed. Frame members shall be accurately formed and coped to their respective intersecting parts. All surfaces shall be smooth. All welds, if used, shall be ground smooth. The window metal frame shall be thermally broken from the exterior. The heat transfer through the frame shall not exceed that specified. Sash stiles, if provided, shall have double flanges, entering into and operating in deep weathering grooves of the frame stiles. Incorporate integral weathering. Muntins shall have accurately joined intersections and be standard type, rigidly attached to the sash. Sash balances, if provided, shall be concealed within the sash.

b. Operators: Operators shall be capable of keeping the windows in the closed position during the design blast event.

c. Glazing: Sash shall be equipped with meeting rails and glazing stops of a type necessary to receive glass units. The glazing bite shall be no less than 1.5 inches, unless otherwise demonstrated through either testing or analysis. The glass will be bonded to the frame by low modulus silicone in accordance with BS 5889, AAMA 800 and AAMA 850.

Contractor is not required to provide separate glazing panels corresponding to indicated mullion configuration. Instead, the Contractor may provide large glazing panels subdivided with surface applied mullions and/or muntins.

2.2 FASTENERS

Fasteners shall be provided of a material in accordance with AAMA/NWWDA 101 I.S.2, warranted by the manufacturer to be non-corrosive and compatible with the window members, trim, hardware, anchors and other components.

2.3 ANCHORS, CLIPS AND WINDOW ACCESSORIES

Anchors, clips, stops and window accessories shall be provided to comply with AAMA/NWWDA 101 I.S.2 and AAMA 907. Provide units and anchorage mechanism with sufficient strength to withstand required design pressure and strength for specified load conditions. The strength capacity of the anchoring system shall be demonstrated by analysis or in a full-scale blast test using the proposed anchoring system for use in the final installation and tested in a window opening of reinforced concrete of a thickness not more than 8 inches thick or in a test frame whose stiffness matches the stiffness of the wall system. Fasteners, clips and window accessories shall be capable of delivering blast and rebound reactions to the adjacent structure.

2.4 SUBFRAME

An integral window subframe will be provided and built into the structure prior to installation of the frame in accordance with the architectural drawings. The subframe and subframe anchors shall be capable of transferring blast and rebound reactions to the adjacent structure, and the frame shall be capable of transferring these reactions to the subframe. The gap between the subframe and the adjacent structure will be sealed with an EPDM sheet.

2.5 HARDWARE

All exterior hardware shall be constructed of corrosion-resistant materials and will conform to all requirement of AAMA/NWWDA 101 I.S.2. Provide manufacturer's standard interior hardware for the operation indicated. Hardware finish shall be selected from manufacturer's standard finish.

2.6 FINISH

Window finishes shall be shop-applied and will conform to all requirements of AAMA 603.8. Window finishes or finish systems shall have a minimum 15-year warranty. The finishes and associated warranty shall be standard from the manufacturer and the same as available to all buyers. The color and gloss of finishes shall be as indicated on the project drawings or

window schedule.

2.7 GLASS

2.7.1 Laminated Glass Units

a. The glass shall be pre-glazed at the factory in accordance with the instructions of the window manufacturer. The glass shall conform to all requirements of ASTM C 1036. Glass thickness shall meet or exceeds the values given in ASTM E 1300 for the design pressure rating of the project.

b. The laminated glass will conform to all requirements of ANSI Z 97.1. The laminated glass shall consist of a minimum of two nominal 3 mm glass panes bonded together with a minimum of a 0.75 mm polyvinyl butral (PVB) inner layer.

2.7.2 Tinted (Light-Reducing) Glass

Tinted (Light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, quality q3 - glazing select, conforming to ASTM C 1036. Thickness, color and light transmission shall be as indicated or as approved.

2.7.3 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1 - clear. Glass shall have a 20 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.8 SETTING MATERIALS

2.8.1 Glazing Compound and Preformed Glazing Sealants

Suitable type in accordance with applicable portions of GANA-GM. Setting materials shall match the window finish, be non-staining, and not require painting. Other materials that will be exposed to view and unpainted shall be black, white or neutral color as on the project drawings or window schedule.

2.8.2 Glazing Accessories

As required to supplement the accessories provided with the items to be glazed and to provide a complete installation, including glazing points, clips, shims, angles, beads, setting blocks, and spacer strips. Ferrous metal accessories that will be exposed in the finished work shall have a finish that will not corrode or stain while in service.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Windows

Install window subframes in accordance with the architectural drawings and the manufacturer's approved installation instructions. Install subframe before the brick and cast stone work. The subframe anchors will have proper devices on which to hang the cast stone sill.

3.1.2 Frame Seals

Seal the gap between the frame and the adjacent structure using an EPDM sheet that will be sealed on both ends with a sealant which is compatible with concrete, finished aluminum and galvanized steel and will conform with all the requirements of B.S 5889. The EPDM sheet shall be installed before starting the brick work.

Install windows in accordance with manufacturer's installation instructions. Install the window prior to the completion of the gypsum board installation at the window head and jambs and the sill board.

3.1.3 Window Seals

Seal window in accordance with the project drawings, manufacturer's approved installation drawings and instructions.

3.2 CLEANING

Window units and glass surfaces shall be thoroughly cleaned with labels, paint spots, putty, and other defacement removed, and shall be clean at the time the work is accepted.

-- End of Section --

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SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1 (1997) Butts and Hinges (BHMA 101)

BHMA A156.2 (1996) Bored and Preassembled Locks and Latches (BHMA 601)

BHMA A156.3 (1994) Exit Devices (BHMA 701)

BHMA A156.4 (1992) Door Controls - Closers (BHMA 301)

BHMA A156.5 (1992) Auxiliary Locks & Associated Products (BHMA 501)

BHMA A156.6 (1994) Architectural Door Trim (BHMA 1001)

BHMA A156.7 (1988) Template Hinge Dimensions

BHMA A156.13 (1994) Mortise Locks & Latches (BHMA 621)

BHMA A156.16 (1997) Auxiliary Hardware

BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)

BHMA A156.21 (1996) Thresholds

BHMA A156.22 (1996) Door Gasketing Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

STEEL DOOR INSTITUTE (SDOI)

SDI 100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bldg Mat Dir (1999) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule; G

Keying system

SD-03 Product Data

Hardware items; G

Card Key Access Control; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

SD-11 Closeout Submittals

Key bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference Publi- cation Type No.	Finish	Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designa- tion
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1.4 KEY BITTING CHART REQUIREMENTS

Submit key biting charts to the Contracting Officer prior to completion of the work. Include:

- a. Complete listing of all keys (AA1, AA2, etc.).
- b. Complete listing of all key cuts (AA1-123456, AA2-123458).
- c. Tabulation showing which key fits which door.
- d. Copy of floor plan showing doors and door numbers.
- e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS

Provide all hardware necessary to meet the requirements of NFPA 80, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bldg Mat Dir or labeled and listed by another testing

laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, locks, latches, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

BHMA A156.1, 114 by 114 millimeters unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 178 by 57 mm with a bushing at least 6 mm long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.3 Cipher Locks

Fully mechanical push button access control cipher lock shall be Simplex/Unican, series 1000, and combination changeable. Lock shall be manufactured by ILCO Unican Corp., Simplex Access Control Division, 2941 Indiana Ave., Winston Salem, NC 27105, USA. Telephone (910)725-1331, FAX (910)725-3269 or approved equal. Cipher lock system shall be a complete mechanical access control system with interchangeable core that unlocks when 5 buttons are pressed in correct sequence. Cipher lock shall not be relock automatically when door closes. The cipher lock shall be capable of code being changed. Access from the interior of stair shall be combination or key override, or passage feature activated from the exterior. Manufacturer shall be furnished complete cipher lock assembly for proper operation.

2.3.4 Card Key Access Control

The card key access control system shall be complete "KABA ILCO" or approved equal system. System shall include electronic card lockset with lever handles as scheduled, card reader as scheduled, dedicated portable lock interrogation and programming unit, dedicated compact computer with software, check-in station and card keys, remote controllers, and all other accessory items.

2.3.4.1 Card Reader

Card reader shall be fully weatherproof, waterproof, and shall be of

slender modular design to fit on the door frame. Controller Box, Power Supply Box, and Transformer shall be provided with the card reader.

2.3.4.2 Dedicated Portable Lock Interrogation and Programming Unit

Battery powered unit with additional external powerpack for programming or viewing and downloading the last 100 lock events from the audit trail. Unit shall include a connection to the server to allow report printing.

2.3.4.3 Dedicated Compact Computer with Internal Modem

Small computer server with proprietary software with customized defaults, password protected data files, internal modem, parallel printer port for system printer shall be provided at each check-in station.

2.3.4.4 Check-in Station and Card Keys

Provide a total of 5 check-in stations for encoding cards. Provide a minimum of 6,000 blankcards, consisting of 3,000 each of 2 different customized designs, with ANSI or ISO standard magnetic strips. Cards shall resist tearing, scratching and shall be water resistant. Card keys shall be serial numbered, 0001-3000 & 3001-6000. AR 190-51, Appendix D requires that all keys shall be controlled. Paragraph D-6e requires that all keys have serial numbers. If a key does not have a serial number, one will be assigned and inscribed on the key. This applies to cards also.

2.3.4.5 Door Hardware

Provide door hardware which can be reprogrammed for future software changes at the door units without replacement of original lock components. Magnetic cards shall be programmed on a time basis only to eliminate out of sequence cards.

2.3.4.6 Extra Materials

Extra Electronic Card Locksets shall be furnished at the rate of 5 locksets for each 100 locksets installed. Extra locksets shall be same as those installed.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have six pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Mortise cylinders shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Keying System

Provide a grand master keying system. Provide key cabinet as specified.

2.3.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.7.1 Knobs and Roses

In addition to meeting test requirements of BHMA A156.2 and BHMA A156.13, knobs, roses, and escutcheons shall be 1.25 mm thick if unreinforced. If reinforced, outer shell shall be 0.89 mm thick and combined thickness shall be 1.78 mm, except knob shanks shall be 1.52 mm thick.

2.3.7.2 Lever Handles

Provide lever handles in lieu of knobs where indicated in hardware sets on the drawing. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 13 mm of the door face.

2.3.8 Automatic Flush Bolts

Automatic flush bolts shall be Type 25 in accordance with BHMA A156.3, and shall be installed at the top and bottom of the inactive leaf of pairs of fire rated doors where specified in the hardware sets. Flush bolts shall be mortised in the strike edge of the door.

2.3.9 Keys

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks @ all locations	3 change keys each lock.
Blank keys:	50 total.

The keys shall be furnished to the Contracting Officer arranged in a container in sets or subsets as scheduled.

2.3.10 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.11 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations. Provide manufacturer's 10 year warranty.

2.3.11.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of

manufacture, and manufacturer's size designation located to be visible after installation.

2.3.12 Door Protection Plates

BHMA A156.6.

2.3.12.1 Sizes of Mop Kick Plates

Width for single doors shall be 50 mm less than door width; width for pairs of doors shall be 25 mm less than door width. Height of kick plates shall be 250 mm for flush doors.

2.3.13 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.14 Miscellaneous

2.3.14.1 High Security Shrouded Hasp

High security shrouded hasp shall be cast stainless steel high security shrouded hasp as manufactured by Howard Sales Company, and shall conform to Mk. 2 Model 9 Style 2, Model NAPEC 0957-right hand, Model NAPEC 0958-left hand, or approved equal.

2.3.14.2 High Security Padlock

High Security Padlock shall be key-operated high security padlock, Sargent and Greanleaf, Inc. Model No. 833-001 or approved equal. The padlock shall meet the following specifications:

12.7 mm (1/2 inch) diameter hardened steel shackle.

19 mm (3/4 inch) wide by 11.1 mm (7/16 inch) high throat opening in shackle shroud.

15.8 mm (5/8 inch) clear shackle opening when locked.

National Stock Number: 5340-01-217-5068.

2.3.14.3 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Where required, thresholds shall be modified to receive projecting bolts of flush bolts and exit devices. Thresholds for doors accessible to the handicapped shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 13 mm.

2.3.15 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". A set shall include head and seals and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 5.48×10^{-5} cms per minute of air per square meter of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

2.3.15.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be bronze anodized.

2.3.15.2 Interlocking Type

Bronze not less than 0.45 mm thick.

2.3.16 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, bronze anodized. Set drips in sealant conforming to Section 07900a, JOINT SEALANT and fasten with stainless steel screws.

2.3.16.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.16.2 Overhead Rain Drips

Approximately 38 mm high by 64 mm projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.17 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.3.18 Padlock Eyes

Padlock eyes for closets doors within living units shall be fabricated of stainless steel and shall be as detailed on the drawings.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless

steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish.

2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 25 mm o.c. and to heads and jambs at 100 mm o.c.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.1.3 High Security Shrouded Hasps

The shrouded hasps must be welded to the arms vault steel door. Install hardware in accordance with manufacturers' printed instructions. Additional mounting instructions can be found at the DOD Lock Program web site (<http://locks.nfesc.navy.mil/>). Refer to the website link called "Standard plans for high security hasps and physical security equipment ashore" for method of attaching Hasp to door. Also, additional information can be determined from MIL-DTL-29181C.

3.2 FIRE DOORS

Install hardware in accordance with NFPA 80 for fire doors.

3.3 HARDWARE LOCATIONS

SDI 100, unless indicated or specified otherwise.

- a. Kick Plates: Push side of single-acting doors. Both sides of double-acting doors.
- b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key.

Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Hardware shall be provided as indicated.

-- End of Section --

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SECTION 08810A

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SECTION 08810A
GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509 (1994) Elastomeric Cellular Preformed Gasket and Sealing Material

ASTM C 669 (1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash

ASTM C 864 (1999) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM C 1036 (1991; R 1997) Flat Glass

ASTM C 1172 (1996e1) Laminated Architectural Flat Glass

ASTM D 395 (1998) Rubber Property - Compression Set

ASTM E 119 (1998) Fire Tests of Building Construction and Materials

ASTM E 1300 (1998) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201 Safety Standard for Architectural Glazing Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-378 (Basic) Putty Linseed Oil Type, (for Wood-Sash-Glazing)

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (1997) Glazing Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 252 (1995) Fire Tests of Door Assemblies

NFPA 257 (1996) Fire Tests for Window and Glass Block Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Two 203 x 254 mm samples of each of the following: tinted glass, annealed glass, wire glass.

SD-07 Certificates

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 5 degrees C and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

PART 2 PRODUCTS

2.1 FLOAT GLASS

2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear tinted, Quality q3 - glazing select, 50 percent light transmittance, 72 percent shading coefficient, conforming to ASTM C 1036. Color shall be bronze.

2.1.2 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, 50 percent light transmittance, 72 percent shading coefficient, conforming to ASTM C 1036. Color shall be bronze.

2.2 ROLLED GLASS

2.2.1 Wired Glass

Wired glass shall be Type II flat type, Class 1 - translucent, Quality q8 - glazing, Form 1 - wired and polished both sides, conforming to ASTM C 1036.

Wire mesh shall be polished stainless steel Mesh 1 - diamond. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 20 minutes

when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.

2.3 LAMINATED GLAZINGS

2.3.1 Laminated Glass

Laminated glass shall consist of two layers of glass, Class 2-tinted Quality q3 - glazing select, conforming to ASTM C 1036. Glass shall be bonded together with 0.76 mm thick PVB interlayer under pressure, or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be bronze. Total thickness of laminated glass shall be nominal 6 mm (1/4 inch).

2.4 FIRE/SAFETY RATED GLASS

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 20, 60 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.5 MIRRORS

2.5.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6 mm (1/4 inch) thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm (1/4 inch) thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint, and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.5.2 Mirror Accessories

2.5.2.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.5.2.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall.

Frames shall be 32 x 6 x 6 mm (1-1/4 x 1/4 x 1/4 inch) continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.5.2.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

2.6 GLAZING ACCESSORIES

2.6.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

2.6.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass.

2.6.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.6.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.6.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.6.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.6.4 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty shall be linseed oil type conforming to CID A-A-378 for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.6.5 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, GANA Glazing Manual and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry.

3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA Glazing Manual, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass and fire/safety rated glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

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SECTION 09250

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SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|--------------|--|
| ANSI A108.11 | (1992) Interior Installation of
Cementitious Backer Units |
| ANSI A118.9 | (1992) Cementitious Backer Units |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM C 36/C 36M | (1999) Gypsum Wallboard |
| ASTM C 79/C 79M | (2001) Standard Specification for Treated
Core and Nontreated Core Gypsum Sheathing
Board |
| ASTM C 442/C 442M | (1999; Rev. A) Gypsum Backing Board and
Coreboard |
| ASTM C 475 | (1994) Joint Compound and Joint Tape for
Finishing Gypsum Board |
| ASTM C 514 | (1996) Nails for the Application of Gypsum
Board |
| ASTM C 557 | (1999) Adhesives for Fastening Gypsum
Wallboard to Wood Framing |
| ASTM C 630/C 630M | (2001) Water-Resistant Gypsum Backing Board |
| ASTM C 840 | (2001) Application and Finishing of Gypsum
Board |
| ASTM C 954 | (2000) Steel Drill Screws for the
Application of Gypsum Board or Metal
Plaster Bases to Steel Studs from 0.033
in. (0.84 mm) to 0.112 in. (2.84 mm) in
Thickness |
| ASTM C 1002 | (2000) Steel Drill Screws for the |

Application of Gypsum Panel Products or
Metal Plaster Bases

ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(1999) Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 253	(1999) Application of Gypsum Sheathing

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2000) Fire Resistance Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious backer units

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-04 Samples

Predecorated gypsum board; G

Submit for each color and pattern of predecorated gypsum board. Where colors are not indicated, submit color selection samples of not less than eight of the manufacturer's standard colors.

SD-07 Certificates

Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 10 degrees C in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

2.1.1.1 Regular

1200 mm wide, 12.7, 15.9 mm thick, tapered, edges.

2.1.1.2 Type X (Special Fire-Resistant)

1200 mm wide, 12.7, 15.9 mm thick, tapered edges.

2.1.2 Glass Mat Covered or Reinforced Gypsum Sheathing for Soffit Board

Exceeds physical properties of ASTM C 79/C 79M and ASTM C 1177/C 1177M. Provide 12.7 mm, gypsum sheathing. Gypsum board shall consist of a noncombustible water-resistant core, with a glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Gypsum sheathing board shall be warranted for at least 6 months against delamination due to direct weather exposure. Provide continuous, asphalt impregnated, building felt to cover exterior face of sheathing.

2.1.3 Cementitious Backer Units

ANSI A118.9.

2.1.4 Joint Treatment Materials

ASTM C 475.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.5 Fasteners

2.1.5.1 Nails

ASTM C 514.

2.1.5.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

2.1.5.3 Staples

1.5 mm thick flattened galvanized wire staples with 11.1 mm wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

<u>Length of Legs (mm)</u>	<u>Thickness of Gypsum Board (mm)</u>
28.6	12.7
31.8	15.9

2.1.6 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.1.6.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

2.1.6.2 Adhesive for Fastening Gypsum Board to Wood Framing

ASTM C 557.

2.1.7 Shaftwall Liner Panel

ASTM C 442/C 442M. Shaftwall liner panel shall conform to UL Fire Resist Dir for the Design Number(s) indicated. Liner Panel shall be specifically manufactured for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 25.4 mm thick, by 610 mm wide.

2.1.8 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.9 Water

Clean, fresh, and potable.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.2.2 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, apply glass matt water-resistant gypsum tile backing board in accordance with ASTM C 840, System X or GA 216.

3.2.3 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C 840, System XI or GA 216.

3.2.4 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publication GA 253. Design details for joints and fasteners shall follow gypsum sheathing manufacturer's requirements and be properly installed to protect the substrate from moisture intrusion. Exposed surfaces of the gypsum sheathing shall not be left exposed beyond the manufacture's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in shingle fashion with edges and ends lapped a minimum of 150 mm. Openings shall be properly flashed. All joints, seams and penetrations shall be sealed with compatible silicone sealant.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, apply cementitious backer units in accordance with ANSI A108.11. A 7.6 kg asphalt impregnated, continuous felt paper membrane shall be placed behind cementitious backer units, between backer units and studs or base layer of gypsum board. Membrane shall be placed with a minimum 150 mm overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint

finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07900a JOINT SEALING. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 9.5 mm bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

3.8 SHAFT WALL FRAMING

The shaft wall system shall be installed in accordance with the system manufacturer's published instructions. Bucks, anchors, blocking and other items placed in or behind shaft wall framing shall be coordinated with electrical and mechanical work. Fireproofing materials which are damaged or removed during shaft wall construction shall be patched or replaced.

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SECTION 09310

CERAMIC TILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 144	(1999) Aggregate for Masonry Mortar
ASTM C 150	(1999a) Portland Cement

ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 241	(1997) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	(1981; R 1996) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 1996) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 847	(1995) Metal Lath
ASTM C 1027	(1999) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(1991) Design Manual IV Dimensional Stone
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TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(1997) Handbook for Ceramic Tile Installation
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the

Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile
Setting-Bed
Mortar, Grout, and Adhesive

Manufacturer's catalog data and preprinted installation and cleaning instructions.

SD-04 Samples

Tile
Accessories
Marble Thresholds

Samples of sufficient size to show color range, pattern, type and joints.

SD-06 Test Reports

Testing

Copy of results for electrical resistance tests.

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 10 degrees C and rising. Temperature shall be maintained above 10 degrees C while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend

beyond a 1-year period shall be provided.

1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 41 kg and 113 kg for floor tile in accordance with ASTM C 648. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum coefficient of friction of 0.50 wet and dry in accordance with ASTM C 1028.

Floor tile shall be Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Color shall be as indicated.

2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed natural clay porcelain unpolished with sharply formed face. Tile size shall be a mixture of standard sizes in a stock pattern. Color shall be as indicated.

2.1.2 Porcelain Tile

Porcelain tile and trim shall be unglazed with the color extending uniformly through the body of the tile. Tile shall meet or exceed the following criteria: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Tile shall comply with 36 CFR 1191 for coefficient of friction for interior floors. Color shall be as indicated.

2.1.3 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with bright glaze. Tile shall be 150 x 150 mm. Color shall be as indicated.

2.1.4 Accessories

Accessories shall be the built-in type of the same materials and finish as the wall tile. Accessories shall be provided as follows:

	Quantity	Location
Recessed porcelain soap dish (PSD)	1	at bathroom @ each module and at each COF shower

2.2 SETTING-BED

The setting-bed shall be composed of the following:

2.2.1 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

2.2.2 Sand

Sand shall conform to ASTM C 144.

2.2.3 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

2.2.4 Metal Lath

Metal lath shall be flat expanded type conforming to ASTM C 847, and weighing not less than 1.4 kg/square meter.

2.2.5 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 50 x 50 mm mesh, 16/16 wire or 38 x 50 mm mesh, 16/13 wire.

2.3 WATER

Water shall be potable.

2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A118.1.

2.4.2 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.3 Ceramic Tile Grout

ANSI A118.6; dry-set grout, latex-portland cement grout, commercial portland cement grout.

2.4.4 Organic Adhesive

ANSI A136.1, Type I.

2.4.5 Cementitious Backer Board

Cementitious backer units shall be in accordance with ANSI A118.9. Thickness of cementitious backer units shall be as indicated.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA Design Manual. Marble shall have a fine sand-rubbed finish and shall be gray in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	3 mm in 2.4 meters	3.0 mm in 3 meters
Latex portland cement mortar	3 mm in 2.4 meters	3.0 mm in 3 meters

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W211-2K and W241-2K.

3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 0.102 mm polyethylene membrane, metal lath, and scratch coat shall also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured

mortar bed and materials shall conform to ANSI A108.1B.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Dry-set or Latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA Hdbk, method F112 or as indicated on drawings.

3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

3.4.2 Dry-Set and Latex-Portland Cement

Dry-set or Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

3.4.4 Waterproofing

Waterproofing under concrete fill shall conform to the requirements of Section 07132a BITUMINOUS WATERPROOFING.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 6 mm in width and shall be grouted full as specified for ceramic tile.

3.6 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways

shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

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SECTION 09510

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e1) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(2001) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	(2000e1) Latex Sealants
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests
ASTM E 1264	(1998) Acoustical Ceiling Products

ASTM E 1414 (2000a) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

ASTM E 1477 (1998a) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir (1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

SD-04 Samples

Acoustical Units

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-06 Test Reports

Ceiling Attenuation Class and Test

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified sound transmission requirements. Data attesting to conformance of the proposed

system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resist Dir may be submitted in lieu of test reports.

SD-07 Certificates

Acoustical Units

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, shall also be I-P products. The Contractor shall coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. If I-P products are used, the Contractor shall be responsible for all associated labor and materials and for the final assembly and performance of the specified work and products. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

1.3.1 Ceiling Attenuation Class and Test

The ceiling attenuation class (CAC) of the ceiling system shall be 40 when determined in accordance with ASTM E 1414. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.3.2 Ceiling Sound Absorption

Determine the NRC in accordance with ASTM C 423 Method of Test.

1.3.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials

shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent shall be maintained for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System A

Type: IV (non-asbestos mineral fiber with membrane-faced overlay).

Minimum NRC: 0.75 in open office areas; 0.60 in conference rooms, executive offices, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

Pattern: C.

Nominal size: 600 by 600 mm.

Edge detail: Square.

Finish: Factory-applied standard white color finish.

Minimum LR coefficient: LR-1, 0.75 or greater.

Minimum CAC: 40.

Flame Spread: Class A, 25 or less

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white finish. Wall molding shall have a flange of not less than 23 mm . Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580.

2.3 HANGERS

Hangers and attachment shall support a minimum 1330 N ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Wires shall conform to ASTM A 641/A 641M, Class 1, 2.7 mm in diameter.

2.3.2 Straps

Straps shall be 25 by 5 mm galvanized steel conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 366/A 366M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.3.3 Rods

Rods shall be 5 mm diameter threaded steel rods, zinc or cadmium coated.

2.4 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.5 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as indicated.

2.6 ACOUSTICAL SEALANT

Acoustical sealant shall conform to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Interior finish work such as plastering, concrete, and terrazzo work shall be completed and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation. Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding shall be secured not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true

alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 5 kg per square m or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings. See Section 07900a JOINT SEALING

3.2 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

3.3 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be neatly stacked on 1220 by 1220 mm pallets not higher than 1220 mm . Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over. Disposal shall be in accordance with Section 01572 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

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SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(2001) Specific Optical Density of Smoke Generated by Solid Materials
ASTM F 1066	(1999) Vinyl Composition Floor Tile
ASTM F 1344	(2000) Rubber Floor Tile
ASTM F 1869	(1998) Measuring Moisture Vapor Emission of Concrete Sub-Floors Using Anhydrous Calcium Chloride

1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648. The smoke density rating shall be less than 450 when tested in accordance with ASTM E 662.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Tile Flooring; G

Drawings indicating location of seams, integral cove, including details of outside corner and cap, and edge strips.

SD-03 Product Data

Tile Flooring
Adhesive for Vinyl Composition Tile
Adhesive for Wall Base

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

SD-04 Samples

Tile Flooring
Wall Base

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 60 x 100 mm .

SD-06 Test Reports

Moisture Test

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

Moisture and Alkalinity Tests

Two copies of test reports of moisture vapor and alkalinity tests of concrete sub floors. Provide starting date of test, person conducting the test and all calculations. Provide a diagram of the building showing test locations with the testing results prior to floor covering installation.

SD-08 Manufacturer's Instructions

Tile Flooring

Copies of flooring manufacturer's recommended installation procedures.

SD-10 Operation and Maintenance Data

Data Package 1; G

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, brands, stock names, production

run, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 21 degrees C for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Do not open containers until materials are to be used, except for inspection to verify compliance with requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

- a. Areas to receive resilient flooring shall be maintained at a temperature above 21 degrees C and below 38 degrees C for 2 days before application, during application and 2 days after application. A minimum temperature of 13 degrees C shall be maintained thereafter.
- b. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.8 EXTRA MATERIALS

Extra flooring material and butt-to base of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 6 m of each color shall be furnished. All extra materials shall be packaged in original containers, properly marked.

PART 2 PRODUCTS

2.1 TILE FLOORING

2.1.1 Vinyl-Composition Style A

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), Composition 1, asbestos-free, and shall be 300 mm square and 3.2 mm thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

2.1.2 Rubber Type A

Rubber tile shall conform to ASTM F 1344 Class 1 homogeneous construction, Type A (solid color) 300 mm square. Surface shall be raised square studs with chamfered edges. Stud profile shall be low. Overall thickness shall

be 3 mm thick.

2.1.3 Lining Felt

Asphalt felt shall be as recommended by flooring manufacturer.

2.1.4 Adhesive for Vinyl Composition Tile

Cutback adhesive for installation of tile over concrete above, on or above grade. Moisture and alkali resistant. Non-asbestos formulated or a latex adhesive recommended by flooring manufacturer.

2.1.5 Adhesive for Wall Base

Adhesive for wall base shall be emulsified acrylic latex; non-flammable.

2.2 STRIPS

2.2.1 Edge

Provide carpet reducer and tile reducer of vinyl and approved by flooring manufacturer. Limit vertical lips in edge strips to 6 mm ; limit total rise to 13 mm .

2.2.2 Feature

Feature strips shall be vinyl or rubber, 25 mm wide, and of thickness to match the flooring. Color shall be as indicated.

2.2.3 Transition

A vinyl or rubber transition strip tapered to meet abutting material shall be provided.

2.3 WALL BASE

Base shall be manufacturers standard rubber or vinyl, straight style (installed with carpet), coved style (installed with resilient flooring) and butt toe cove (installed with 3 mm thick flooring). Base shall be 100 mm high and a minimum 3 mm thick, in approved color, and in matte finish.

Preformed outside corners shall be furnished. Use flexible base to conform to irregularities in walls, partitions, and floors. Provide premolded corners in matching size, shape, and color for all right-angle inside and outside corners.

2.4 POLISH/FINISH

Polish shall conform to ASTM D 4078. Use flooring manufacturer's standard high-solids finish for shine without buffing; non-flammable; compatible with factory-applied finish; may be buffed or burnished for maximum gloss.

2.5 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07900a JOINT

SEALING.

2.6 MANUFACTURER'S COLOR AND TEXTURE

Color and distinct pattern shall be uniformly distributed throughout thickness of tile. Color and texture shall be as indicated. Flooring in continuous area or replacement of damaged flooring in continuous area shall be from same production run with same shade and pattern,

2.7 CONCRETE MOISTURE VAPOR TREATMENT

Concrete sub-floors exceeding 1.36 kg/93 m²/24 hrs (3 lbs./1000 square feet/24 hrs.) of vapor emission and a pH level greater than 10, shall receive moisture vapor treatment (hereafter stated as Treatment). Treatment shall reduce emission levels to 1.36 kg/93 m²/24 hrs (3 lbs./1000 square feet/24 hrs.) or lower (provide testing after curing of Treatment to verify that Treatment has reduced emission to 1.36 kg/93 m²/24 hrs (3 lbs./1000 square feet/24 hrs.), lower pH levels to 10 or lower, and provide a suitable surface for the bonding of floor covering materials. The treatment shall not produce detrimental conditions to the concrete slab or the floor covering materials by producing too low levels of emission or pH.

Treatment material will consist of a two component penetrating polymer with elastomeric properties and vapor control at joints and cracks. The Treatment material shall be specifically formulated for flooring treatment.

Installed Treatment material shall be compatible with the flooring adhesives. A written statement stating compatibility from the Treatment manufacturer shall be submitted to the Contracting Officer. Treatment manufacturer and installer will provide proof of the following:

a. Evidence of 5 successful floor Treatment projects, with a minimum of 8 years of age.

b..Warranty covering the material and installation for a period of 10 years. Manufactures standard warranty shall provide the following coverage:

1. Cover the installed moisture vapor treatment, cementitious materials, floor coverings and adhesives in the event that treatment is affected by vapor emission and/or pH levels.

2. Evidence of a product liability insurance policy with an insurer of not less than an "A" rating from one of the 4 major rating services. A certificate of insurance shall be delivered in the amount of \$2,000,000.00 per occurrence to the owner and the general contractor as co-insured.

c. Installer shall provide proof of installer certification by the Treatment manufacturer and bondability in the amount of the contract.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any

corrective action without written permission from the Government.

3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

3.2.1 Concrete Floor

Grind ridges and other uneven surfaces smooth. Cut out and fill cracks 2 mm or wider with crack filler. Provide mastic underlayment to fill remaining holes, cracks, and depressions and for smoothing, leveling, or creating a feather edge in accordance with instructions of mastic manufacturer. After cleaning and removal of loose particles, prime chalky or dusty surfaces with primer recommended by flooring manufacturer.

3.2.2 Final Cleaning of Substrate

Clean substrate with broom or vacuum immediately prior to the installation of flooring.

3.3 MOISTURE TEST

The concrete slab shall be allowed to cure for a period of at least two months and exposed to air conditioning, etc. for the purpose of acclimating the slab for at least 3 weeks prior to taking the moisture test. This time period may be shortened if use of the Relative Humidity testing determines a shorter curing/acclimation time period is required prior to performing the moisture test. Resulting test holes in the concrete slab shall be repaired by an approved method. The concrete slab shall be protected from the weather by a Contracting Officer's approved method during the curing and acclimation period. Concrete slab shall be tested for moisture emission rate and excessive alkalinity in accordance with ASTM F 1869 (anhydrous calcium chloride test) and Resilient Floor Covering Institute RFCI. Provide anhydrous calcium chloride at a rate of three test in areas up to 93 m² (1,000 square feet) and one additional test per 93 m² (1000 square feet) thereafter. Provide industry standard pH testing at the same rate.

3.4 GENERAL APPLICATION REQUIREMENTS

To avoid damage, install flooring after other work in same area has been completed. Apply flooring and accessories in accordance with manufacturer's directions, using experienced workers. Detailed requirements follow:

- a. Adhesives: Do not allow smoking, open flames or other sources

of ignition in area where solvent-containing adhesives are being used or spread, after posting conspicuous signs reading "NO SMOKING OR OPEN FLAME".

b. Flooring: Apply in patterns indicated. Start in center of room or area, and work toward edges. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles in field, but no edge tile shall be less than one-half full size, except where irregular-shape makes it impossible.

c. Cutting: Cut flooring edges and scribe to walls and partitions after field flooring has been applied.

d. Edge Strips: Provide edging strips where flooring terminates at points higher than contiguous finished flooring, except where thresholds are provided. Secure plastic strips with adhesive.

3.5 INSTALLATION OF VINYL-COMPOSITION TILE AND SOLID VINYL TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.6 INSTALLATION OF RUBBER FLOORING

Rubber flooring shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge pieces shall be less than one-half the field size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edges shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.7 INSTALLATION OF FEATURE STRIPS

Edge strips shall be secured with adhesive as recommended by the manufacturer. Edge strips shall be provided at locations where flooring termination is higher than the adjacent finished flooring, except at doorways where thresholds are provided. At doors, locate edge strip under door centerline.

3.8 INSTALLATION OF WALL BASE

Wall base shall be installed with adhesive in accordance with the

manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.9 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be dry-cleaned to remove all surplus adhesive. No sooner than 5 days after installation, flooring shall be washed with a nonalkaline cleaning solution, rinsed thoroughly with clear cold water, and, except for raised pattern rubber tile, given two coats of polish in accordance with manufacturers written instructions. Raised pattern rubber tile shall be cleaned and maintained as recommended by the manufacturer.

- a. Vinyl flooring, except prewaxed flooring and flooring designated as no-wax or never-wax by manufacturer, shall be buffed to an even sheen without polish with an electric polishing machine, using a lamb's wool pad when dry buffing.

3.10 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled, and cove base which is not tight to backing fillet shall be removed and replaced.

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SECTION 09880

ACRYLIC TEXTURED WALL COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84 (1995; Rev. A) Surface Burning Characteristics of Building Materials

ASTM E 96 (1995) Water Vapor Transmission of Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Acrylic Textured Wall Coating

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular batch is 200 L or less.

Include material description and physical properties, application details, and recommendations regarding shelf life, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

SD-08 Manufacturer's Instructions

Mixing and Thinning; Application

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and

curing and drying times between coats.

SD-07 Certificates

Applicator's Qualifications

Submit evidence that the Contractor has satisfactorily applied acrylic textured wall coating at a minimum of two sites on gypsum board, concrete and concrete masonry surfaces. Indicate the names and locations of the sites, and type and design of the equipment used, including safety devices.

Acrylic Textured Wall Coating

Manufacturer's certification of acrylic textured wall coating materials shall meet or exceed the specified physical and performance characteristics. Materials not certified are not permitted in the work area.

SD-04 Samples

Color; Acrylic Textured Wall Coating

Submit manufacturer's sample of coating colors. Cross reference color samples to color scheme as indicated.

Submit two each 50 mm thick by 203 mm wide by 406 mm long concrete masonry cap block samples and two each 203 mm by 203 mm by 13 mm thick gypsum board samples of manufacturer's color samples for acrylic coating in color and finish as indicated. The color samples shall be divided into horizontal strips and coated as follows:

Sample on CMU:

- a. Skimming compound
- b. Primer coat
- c. Finish coat

Sample on Gypboard:

- a. Primer coat
- b. Finish coat

1.3 DELIVERY AND STORAGE

Deliver manufactured materials in manufacturer's original, unopened containers, with labels intact and legible. Containers having materials covered by a referenced specification number shall bear material specification number, type, and class of the contents. Deliver materials in

sufficient quantity so that the work continues without interruptions. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Store materials in areas with temperature below 38 degrees C. When hazardous materials are involved, rigid adherence to the special precautions of the manufacturer, as modified by local, state and federal authorities, shall be followed. Promptly remove from the site materials or any incomplete work adversely affected by exposure to moisture.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Seamless Acrylic Textured Wall Coating

Coating shall be all acrylic based possessing outstanding adhesion to various substrates. The cured acrylic textured wall coating shall meet or exceed the following physical and performance characteristics:

Property -----	Typical Value -----	Test Method -----
Hardness	35.0 or greater	Barcoll Hardness Index
Fire Rating Flame Spread	8.5 or less	ASTM E 84
Smoke Contribution	7.0 or less	ASTM E 84
Scrubability	0.001-inch or less	200 strokes of stiff brush with soap and water
Permeance	27.5 perms	ASTM E 96
Solvent Resistance -----		
Water	No change	1-hour soak
Detergent	No change	1-hour soak
Ethanol	No change	1-hour soak
Naphtha	No change	1-hour soak
Ethelene glycol	No change	1-hour soak
Mineral spirits	No change	1-hour soak
Ammonium hydroxide	Slight softening	1-hour soak
Bleach (household)	Slight softening	1-hour soak
409 Cleaner	Slight softening	1-hour soak

Property	Typical Value	Test Method
-----	-----	-----
Paint Remover	Surface softening	1-hour soak
Stain Resistance		

Water	No Stain	409 Cleaner
Blood	No Stain	409 Cleaner
Urine	No Stain	409 Cleaner
Coffee	No Stain	409 Cleaner
Tea	No Stain	409 Cleaner
Blueberry	No Stain	409 Cleaner
Mustard	No Stain	409 Cleaner
Mildew Resistance	No visible mildew	Incubation for 90 days in 35 degrees C and 90 percent RH
Color Pigments	All pigments pure and nonfading.	

2.1.2 Skimming Compound

An interior/exterior, one part, water based acrylic, high performance skimming and filling compound, compatible with acrylic coating, and approved by the manufacturer of the acrylic textured wall coating.

2.2 COLOR AND TEXTURE

Color and texture shall be as indicated.

PART 3 EXECUTION

3.1 SURFACE PREPARATION OF SURFACES

3.1.1 Curing Time

Uncured concrete, masonry, and other cementitious surfaces shall be cured for not less than 30 calendar days.

3.1.2 Dirt, Grease, and Oil

Wash surfaces with a solution composed of 89 mL (2/3 cup) trisoclium phosphate, 30 mL (1/3 cup) household detergent, and 2.8 L of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

3.1.3 Fungus and Mold

Wash surfaces with a solution composed of 89 mL (2/3 cup) trisoclium phosphate, 30 mL (1/3 cup) household detergent, and 0.95 L 5 percent sodium

hypochlorite solution and 2.8 L of warm water. Rinse thoroughly with fresh water.

3.1.4 Glaze and Loose Particles

Remove by wire brushing.

3.1.5 Efflorescence

Remove by scraping or wire brushing followed by washing with a 5-to 10-percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

3.1.6 Cosmetic Repair of Minor Defects

Repair or fill mortar joints and minor defects, including but not limited to spalls, with skimming compound in accordance with manufacturer's recommendations and prior to coating application. Allow skimming compound to cure for 24 hours.

3.1.7 Gypsum Wallboard Surfaces

Prepare gypsum wallboard to industry acceptable standards necessary for application of vinyl wallcovering. Remove excess taping compound dust. Dampen surface slightly with light spray mist of water just prior to application of coating.

3.1.8 Concrete and Concrete Masonry Surfaces

Prepare concrete and concrete masonry surfaces by cleaning to remove dust, grease, form release agents, etc., then patch all major holes and honeycombs using structural grout manufactured for the purpose as specified in the concrete Division of these specifications. Then grind all projections above the planar surface until flush. Fill, and float smooth all recessed form seams and other minor imperfections using a skimming compound as recommended by the manufacturer. Allow acrylic surfacing compound to dry at least 24 hours under nominal conditions. Dampen dry cementitious surfaces just prior to installation of acrylic surfacing compound materials. Wipe away any active condensation or surface water sufficient to cause a wet glaze prior to beginning installation.

3.2 MATERIAL PREPARATION

Stir materials before application with power drill and a drywall compound paddle. Stir at approximately 350 RPM for three minutes while removing material from all sides and bottom of the container. Stir only as much material as will be used in a four hour period or restir material left sitting in excess of 4 hours. Retain lid on containers until the material is in actual use. Do not leave containers open for more than one hour.

3.2.1 Thinning

Coating materials come premixed wet and with color already in the container. Should storage or shipping expose materials to excessively high or low temperatures, viscosity may be affected. Thinning may be done with small amount of water in accordance with manufacturer's printed instructions.

3.3 APPLICATION

3.3.1 General

Apply coating materials in accordance with manufacturer's instruction and recommendations as required to achieve the appearance of the approved samples and performance as specified herein. Skimming compound shall be first applied over concrete masonry surfaces only. Coating materials shall be in two coats, primer coat and finish coat. Final dry film thickness shall be a minimum average of .8 mm (30 mils).

3.3.2 Primer Coat

Apply acrylic coating manufacturer furnished primer at the rate of 22.3 sq meters (240 square feet) per gallon. Apply with a spray or roller as recommended by the manufacturer. Allow to cure until firmly set for not less than 2 hours.

3.3.3 Finish Coat

Apply finish coat at rate of 16.72 sq meters (180 square feet) per 60 pound net pail. Apply with a spray or roller to achieve visible coverage. Wet film thickness shall be approximately .8 mm (30 mils). Apply finish coat to a uniform level finish without holidays or runs. Finish with a textured float finish with minimal blade marks to match approved samples. Allow to cure until firmly set for not less shall 24 hours.

3.4 PROTECTION

Before start of spraying, all surfaces that do not require coating shall be completely masked and protected. Adequate drop cloths shall be provided over floors and adjacent surfaces that are not scheduled for treatment.

3.5 CLEANUP

Remove from the job site each day all debris, scraps, containers, and all other rubbish and trash resulting from the installation of the coating systems. Clean and touchup as necessary to restore coating work to new and unblemished condition.

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SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values (1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC Documentation of Threshold Limit Values and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1 Scheme for Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 523 (1999) Standard Test Method for Specular Gloss

ASTM D 2092 (1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting

ASTM D 4263 (1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM F 1869 (1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000 Air Contaminants

FEDERAL STANDARDS (FED-STD)

FED-STD-313 (Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 9	(2001) Exterior Alkyd Enamel
MPI 11	(2001) Exterior Latex, Semi-Gloss
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 45	(2001) Interior Primer Sealer
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 50	(2001) Interior Latex Primer Sealer
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 108	(2001) High Build Epoxy Marine Coating
MPI 110	(2001) Interior/Exterior High Performance Acrylic
MPI 134	(2001) Waterborne Galvanized Primer
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS-EPP-SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints
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STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PA 3	(1995) Safety in Paint Application

SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS-EPP-SP01-01 shall be given preferential consideration over registered products. Products that are

registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address

of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

- a. Name of individual and proposed position for this work.
- b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality

Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH TLV-DOC confirmed

human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures below 35 degrees C.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH Limit Values, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 3 degrees C above dew point;
- b. Over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer

recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated on the drawings.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing new coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces, of the buildings and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, elevator shafts and chases.
- c. Steel to be embedded in concrete, unless specified otherwise.
- d. Copper, stainless steel, aluminum, brass, and lead.
- e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
 - (1) Exposed piping, conduit, and ductwork;
 - (2) Supports, hangers, air grilles, and registers;
 - (3) Miscellaneous metalwork and insulation coverings.
- b. Do not paint the following, unless indicated otherwise:
 - (1) New zinc-coated, aluminum, and copper surfaces under insulation
 - (2) New aluminum jacket on piping
 - (3) New interior ferrous piping under insulation.

1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

- a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm in attic spaces, spaces above suspended ceilings, pipe chases, mechanical equipment room, and spaces where walls or

ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals.

- b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.10.4 Definitions and Abbreviations

1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.4.7 EXT

MPI short term designation for an exterior coating system.

1.10.4.8 INT

MPI short term designation for an interior coating system.

1.10.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting

Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).
The Division number follows the CSI Master Format.

1.10.4.14 Paint

See Coating definition.

1.10.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Brush-off blast remaining surface in accordance with SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 10/SSPC SP 12 WJ-2.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

- a. New Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

- a. Curing: Concrete and masonry surfaces shall be allowed to cure at least 30 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
 - (1) Dirt, Grease, and Oil: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water.

- (2) Fungus and Mold: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.
 - (3) Paint and Loose Particles: Remove by wire brushing.
 - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
 - d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

- a. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.
- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces.

- a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.

- b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.
- c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.
- d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- e. Cosmetic Repair of Minor Defects:
 - (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
 - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
 - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

3.5.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

- a. **Drying Time:** Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. **Primers, and Intermediate Coats:** Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. **Finished Surfaces:** Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. **Thermosetting Paints:** Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when

thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
 Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 3. Interior Concrete Paint Table
 Division 4. Interior Concrete Masonry Units Paint Table
 Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
 Division 6. Interior Wood Paint Table
 Division 9: Interior Gypsum Board, Textured Surfaces
 Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
- (1) One coat of primer.
 - (2) One coat of undercoat or intermediate coat.

- (3) One topcoat to match adjacent surfaces.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.
- e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in Division 6 for Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101 or ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101 or ANSI A13.1, stencil approved names or code letters, in letters a minimum of 13 mm high for piping and a minimum of 50 mm high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

- A. New concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)
- | | | |
|-------------|---------------|----------|
| Primer: | Intermediate: | Topcoat: |
| MPI 11 | MPI 11 | MPI 11 |
| System DFT: | 88 microns | |

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

- A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
- | | | |
|------------------------------|---------------|----------|
| New; MPI EXT 5.1Q-G6 (Gloss) | | |
| Primer: | Intermediate: | Topcoat: |
| MPI 23 | MPI 9 | MPI 9 |
| System DFT: | 131 microns | |

- B. New Steel that has been blast-cleaned to SSPC SP 6:

2. Alkyd
- | | | |
|--|---------------|----------|
| New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6 | | |
| Primer: | Intermediate: | Topcoat: |
| MPI 79 | MPI 9 | MPI 9 |
| System DFT: | 131 microns | |

- C. New steel blast cleaned to SSPC SP 10:

1. Waterborne Light Industrial
- | | | |
|-------------------------|---------------|------------|
| MPI EXT 5.1R-G6 (Gloss) | | |
| Primer: | Intermediate: | Topcoat: |
| MPI 101 | MPI 108 | MPI 110-G6 |

STEEL / FERROUS SURFACES

System DFT: 212 microns

EXTERIOR GALVANIZED SURFACES

D. New Galvanized surfaces:

1. Waterborne Primer / Latex
MPI EXT 5.3H-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 11 MPI 11
System DFT: 112 microns

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New Concrete, vertical surfaces, not specified otherwise:

1. High Performance Architectural Latex
New; MPI INT 3.1C-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 141 MPI 141
System DFT: 100 microns

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

1. High Performance Architectural Latex
MPI INT 4.2D-G5 (Semigloss)
Filler Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 141 MPI 141
System DFT: 275 microns

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd
MPI INT 5.1E-G5 (Semigloss)
Primer: Intermediate: Topcoat:

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DIVISION 10 - SPECIALTIES

SECTION 10100A

VISUAL COMMUNICATIONS SPECIALTIES

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- 1.4 DELIVERY, STORAGE AND HANDLING
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- 2.2 MATERIALS
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 - 2.2.2 Cork
 - 2.2.2.1 Colored Cork
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SECTION 10100A

VISUAL COMMUNICATIONS SPECIALTIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM F 148	(1995) Binder Durability of Cork Composition Gasket Materials
ASTM F 152	(1995; R 2002) Tension Testing of Nonmetallic Gasket Materials

1.2 GENERAL REQUIREMENTS

The term visual display board when used herein includes marker boards, and tackboards. Visual display boards shall be from manufacturer's standard product line.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Visual Display Boards

Manufacturer's descriptive data and catalog cuts.
Manufacturer's installation instructions, and cleaning and
maintenance instructions.

SD-04 Samples

Aluminum

Sections of frame, map rail, and chalktray, and two map hooks.

Porcelain Enamel

Section showing porcelain enamel coating, steel, core material and backing.

Materials.

Section of core material showing the lamination of colored cork, and natural cork. Sample of hardwood and plastic laminate finish, and glass type. Samples shall be minimum 100 by 100 mm and show range of color.

07 Certificates

Visual Display Boards

Certificate of compliance signed by Contractor attesting that visual display boards conform to the requirements specified.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the building site in the manufacturer's original unopened containers and shall be stored in a clean dry area. Materials shall be stacked according to manufacturer's recommendations. Visual display boards shall be allowed to acclimate to the building temperature for 24 hours prior to installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 COLOR

Finish colors for required items shall be as indicated.

2.2 MATERIALS

2.2.1 Porcelain Enamel

Marker board writing surface shall be composed of porcelain enamel fused to a nominal 0.378 mm (28 gauge) thick steel, laminated to a minimum 6 mm thick core material with a steel or foil backing sheet. Writing surface shall be capable of supporting paper by means of magnets. Marker board surface for display track system may be a powder paint dry erase surface adhered to a nominal 1.214 mm (18 gauge) thick steel.

2.2.2 Cork

Cork shall be a continuous resilient sheet made from soft, clean,

granulated cork relatively free from hardback and dust and bonded with a binder suitable for the purpose intended. The wearing surface shall be free from streaks, spots, cracks or other imperfections that would impair its usefulness or appearance. The material shall be seasoned, and a clean cut made not less than 13 mm from the edge shall show no evidence of soft sticky binder.

2.2.2.1 Colored Cork

Colored cork shall be composed of pure cork and natural color pigments that are combined under heat and pressure with linseed oil. Colored cork shall be colored throughout and shall be washable. The burlap backing shall be deeply imbedded and keyed to the work sheet being partially concealed in it and meeting the requirements of ASTM F 148.

2.2.2.2 Natural Cork

Material shall be a single layer of pure grain natural cork without backing or facing. The color shall be light tan. The cork sheet shall have a tensile strength of not less than 275 kPa when tested in accordance with ASTM F 152.

2.2.3 Aluminum

Aluminum frame extrusions shall be alloy 6063-T5 or 6063-T6, conform to ASTM B 221M, and be a minimum 1.5 mm thick. Exposed aluminum shall have an anodized, satin finish. Straight, single lengths shall be used wherever possible. Joints shall be kept to a minimum. Corners shall be mitered and shall have a hairline closure.

2.3 WHITE/MARKERBOARD

Markerboard/whiteboard shall have a porcelain enamel writing surface and a chalktray. Markerboard/whiteboard shall be a factory assembled unit complete in one piece, without joints whenever possible. When markerboard/whiteboard dimensions require delivery in separate sections, components shall be prefit at the factory, disassembled for delivery and jointed at the site. Frame shall be aluminum. Chalktray shall be the same material as the frame and extend the full length of the liquid markerboard/whiteboard. The markerboard shall have a map rail. The map rail with a tackable insert shall extend the full length of the liquid chalkboard, and shall have map hooks with clips for holding sheets of paper. Two map hooks shall be provided for each 1220 mm of map rail. Dry erase markings shall be removable with a felt eraser or dry cloth without ghosting. Each unit shall come complete with an eraser and four different color compatible dry erase markers. The size shall be as shown in the drawings.

2.4 TACKBOARDS/BULLETIN BOARD

2.4.1 Cork

Tackboard/bulletin board shall have aluminum frame and plexiglass doors as detailed on the drawings. Tackboard/bulletin board shall consist of a

minimum 6 mm thick colored cork with burlap backing laminated to a minimum 6 mm thick hardboard. Doors for tackboard/bulletin boards located in the same area should be keyed alike.

2.5 PROJECTION SCREEN

Ceiling Recessed mount motorized projection screen shall have 120V motor that is lubricated for life, quick reversal type, has overload protector, integral gears, and preset accessible limit switches as scheduled.

PART 3 EXECUTION

3.1 PLACEMENT

Location and mounting height of visual display boards shall be as shown on the drawings.

Mounting height is defined as distance from finished floor to top of the display board frame.

3.2 INSTALLATION

Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Visual display boards shall be attached to the walls with suitable devices to anchor each unit. The Contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Visual display boards shall be installed in locations and at mounting heights indicated. Visual display boards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

3.3 CLEANING

Writing surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

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SECTION 10153

TOILET PARTITIONS

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SECTION 10153

TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)

ATBCB ADA TITLE III (1998) ADA Accessibility Guidelines for -
Buildings and Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003 (Basic) Partitions, Toilet, Complete

1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Toilet Partition System.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Samples

Toilet Partition System.

Manufacturer's standard color charts and color samples.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style A, floor supported. Width, length, and height of toilet enclosures shall be as indicated on the drawings. Finish surface of panels shall be laminated plastic, Finish 3. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be reinforced for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 1112 N . Grab bars shall not rotate within their fittings.

2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, Style A, floor supported. Finish surface of screens shall be laminated plastic, Finish 3. Width and height of urinal screens shall be 600 mm by 1219 mm high. Secure wall hung urinal screens with 1050 mm long, continuous flanges.

2.3 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with ATBCB ADA TITLE III and shall be stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator.

2.4 COLORS AND FINISHES

2.4.1 Colors

Color of finishes for toilet partition system components shall be as indicated on the drawings.

2.4.2 Finishes No. 1 through No. 3

Partitions, panels, screen, and door finishes shall conform to CID A-A-60003 and shall be Finish No. 3, laminated plastic.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb with uniform clearance of 13 mm between pilasters and panels; 25 mm between pilasters and walls; and not more than 5 mm between pilasters and doors, in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by through-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work. In the finished work, conceal evidence of drilling in floors and walls. Screws and bolts shall be stainless steel.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 5 mm and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

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- 2.5 ANODIC COATING
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- 2.7 ANCHORS AND FASTENERS
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SECTION 10430

EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 26/B 26M (1999) Aluminum-Alloy Sand Castings

ASTM B 108 (1999) Aluminum-Alloy Permanent Mold Castings

ASTM B 209M (2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 221M (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM E 84 (2000a) Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1 (2000) Recommended Practices for Resistance Welding

1.2 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3 WIND LOAD REQUIREMENTS

Exterior signage shall be designed to withstand 170 km/h windload.

1.4 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Modular Exterior Signage System

Manufacturer's descriptive data and catalog cuts.

Installation

Manufacturer's installation instructions and cleaning instructions.

Exterior Signs

Exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message.

SD-04 Samples

Exterior Signs

One sample of each type of sign. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and

location recorded. Two samples of manufacturer's standard color chips for each material requiring color selection and 305 mm square sample of sign face color sample.

1.6 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.7 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown.

2.1.1 Panel And Post/Panel Type Signs

2.1.1.1 Posts

One-piece aluminum posts shall be provided with minimum 3.2 mm wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.1.2 Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.1.3 Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 3.2 mm aluminum. Panels with metal return sheeting shall have welded corners, ground smooth. Panels shall be heliarc welded to framing system.

2.1.1.4 Post Finish and Panel System Finish

Post finish and panel framing system finish shall be anodized conforming to AA DAF-45, AA-M21C22A42, or AA-M21C22A44, 0.7 mil thick (minimum). Color of anodized coating shall match the color of existing exterior signs at Schofield Barracks and shall be as follows: Post Color: Black anodized; Panel Framing: Brown anodized.

2.1.1.5 Sign Message Face Panel Finish

Sign message face panel finish shall be a reflective sheeting background, engineer grade premium quality, wide angularity enclosed lens retro-reflective material to meet or exceed the standards of: - General Services Administration, Federal Supply Service Specification, L-S-300-C, Reflectivity 1. - U.S. Department of Transportation, Federal Highway Administration, Standard Specifications for Construction of Roads and Bridges on Federal Highway projects, current edition FP-85 Sections 633.0-6 and 718.01. Background application to aluminum shall be heat activated as recommended by the manufacturer. Panel shall be covered with one unsplices sheet, unless the dimension is larger than 1219 mm (48 inch) in vertical direction. Splices shall be positioned so that top piece shall overlap bottom piece by a minimum of 12.7 mm (0.5 inch) but not more than 19 mm (0.75 inch). Spliced sheets shall be color matched. Color of reflective sheeting background shall match the color existing exterior signs at Schofield Barracks, "Scotchlite 3M, Brown 2279 Reflective sheet engineer grade" or approved equal.

2.1.1.6 Mounting

Permanent mounting shall be provided by embedding posts in concrete foundation as shown.

2.1.2 Changeable Letter Directories

2.1.2.1 Frame and Trim

Aluminum alloy finish shall be Park Bronze Anodized conforming to AA DAF-45, AA-M21-C-22-A42, or AA-M21-C22-A44, Architectural Class I (0.7 mil or thicker).

2.1.2.2 Header Panel

Baked enamel background finish on metal sheet with precision cut vinyl letters applied on the front side.

2.1.2.3 Door Glazing

Door glazing shall be clear safety or tempered glass minimum 6 mm thick.

2.1.2.4 Door Construction

Door frame shall be of same material and finish as surrounding frame. Corners shall be mitered, reinforced, welded, and assembled with concealed fasteners. Hinges shall be standard with manufacturer, in finish to match

frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.1.2.5 Door Locks

Door locks shall be manufacturer's standard and shall be keyed differently. Lock finish shall match frame finish.

2.1.2.6 Fabrication

Frames and trim shall be assembled with corners reinforced, welded and mitered to hairline fit, with no exposed fasteners. Removable changeable directory panel shall consist of vinyl covering backgrooved 6 mm on centers to receive letters.

2.1.2.7 Finishes

Post finish shall be anodized conforming to AA DAF-45. Metal panel system finish shall be baked enamel.

2.1.2.8 Mounting

Directories shall be mounted to supporting structures with concealed fasteners in accordance with manufacturer's instructions.

2.1.2.9 Changeable Letters

Changeable letters shall be upper-case or upper and lower-case helvetica medium. Tabbed vinyl letters and numbers shall be furnished in accordance with the drawings.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics

Signage graphics shall conform to the following:

Pressure sensitive precision cut vinyl letters shall be provided. Color of vinyl letters shall match the colors of existing exterior signs at Schofield Barracks, "3M GSP Gerber P20886C, 15" HP Beige or approved equal.

2.2.2 Messages

See drawings and schedule for message content. Typeface: Helvetica medium. Type size as indicated.

2.3 DIMENSIONAL BUILDING LETTERS

2.3.1 Fabrication

Letters shall be fabricated from cast bronze. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

2.3.2 Typeface

Typeface shall be helvetica medium as indicated.

2.3.3 Size

Letter size shall be as indicated.

2.3.4 Finish

Polished bronze with clear coat finish shall be provided.

2.3.5 Mounting

Threaded studs or Steel U-bracket, cap screws, and expansion bolts or toggle bolts of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209M for sheet or plate, ASTM B 221M for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings.

Aluminum extrusions shall be provided at least 3 mm thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.

2.5 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Integrated color anodized designation AA-M21-C22-A42 or AA-M21-C22-A94, Architectural Class I (0.7 mil or greater).

2.6 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E 84 and shall be a minimum 0.08 mm film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.7 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish. Exposed fasteners shall be tamper-proof.

2.8 SHOP FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for

installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

PART 3 EXECUTION

3.1 INSTALLATION

Signs or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, the Contractor shall cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

-- End of Section --

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SECTION 10440

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SECTION 10440

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

- AA DAF-45 (1997) Designation System for Aluminum Finishes
- AA PK-1 (1999) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 209M (2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
- ASTM B 221M (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
- ASTM C 1036 (1991; R 1997) Flat Glass

AMERICAN WELDING SOCIETY (AWS)

- AWS D1.2 (1997) Structural Welding Code - Aluminum

FEDERAL STANDARDS (FED-STD)

- FED-STD 795 (1988) Uniform Federal Accessibility Standards

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191

Americans with Disabilities Act (ADA)
Accessibility Guidance for Buildings and
Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

- a. Directional sign.
- b. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 75 mm .

1.3.2 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 0.8 mm upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 16 mm in height, but no higher than 50 mm . Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 152 mm minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 EXTRA STOCK

The Contractor shall provide extra stock of the following: 5 blank plaques plates of each color and size for sign types and 50 changeable message strips for each sign type.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Plaque signs shall be modular type signage system. Signs shall be fabricated of acrylic plastic conforming to ANSI Z97.1.

2.1.1 Standard Room Signs

Plaque signs shall consist of matte finish acrylic plastic thickness and size as shown. Corners of signs shall be as shown.

2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of cast acrylic or vinyl or as standard with the manufacturer. Plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be squared.

2.1.3 Type of Mounting For Signs

Surface mounted signs shall be provided with 1.6 mm thick vinyl foam tape.

2.1.4 Graphics

Signage that provides permanent general circulation directions or identification of spaces shall be tactile (perceptible to touch) and shall comply with 36 CFR 1191. The 36 CFR 1191 requirements must provide equal greater accessibility than the requirements of FED-STD 795. Characters, symbols, or pictographs on tactile signs shall meet 36 CFR 1191, Grade 2 braille. Characters and symbols shall contrast with their background.

2.1.5 Graphics Application

Signage graphics shall conform to the following:

- a. Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. No handcut screens will be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.
- b. Tactile characters and symbols shall be raised 1.0 mm minimum from the sign face. Signs shall be of the piece construction. Add-on characters are not acceptable.

2.1.6 Messages

See drawings and schedules for message content, typeface: Helvetica medium. Type size as indicated.

2.2 BUILDING DIRECTORIES

Building directories shall be lobby directories or floor directories, and shall be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign shall be as shown on the drawings. Where required, message content shall be as shown on drawings and schedule.

2.2.1 Header Panel

Header panel shall be acrylic with raised acrylic letters.

2.2.2 Doors

2.2.2.1 Door Glazing

Door glazing shall be in accordance with ASTM C 1036, Type 1, Class 1, Quality 3, minimum 6 mm thick.

2.2.2.2 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered, reinforced, and assembled with concealed fasteners. Hinges shall be standard with the manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.2.2.3 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike.

2.2.3 Fabrication

Extruded aluminum frames and trim shall be assembled with corners reinforced and mitered to a hairline fit, with no exposed fasteners.

2.2.4 Changeable Letter/Message Strip Directory System

Directory shall consist of a non-illuminated unit with cast vinyl. Design of unit shall be as shown in the drawings.

2.2.4.1 Construction

The directory shall be constructed of an aluminum 38 mm deep frame with satin dark bronze anodized finish. Unit shall be surface mounted. Unit shall have a header with lettering as shown. Unit shall have a concealed hinge door and locking system. Door frame shall be anodized aluminum with satin black dark bronze finish.

2.2.4.2 Message Strips

Namestrips shall be updatable by user with lettering machine.

2.3 LETTERING MACHINE

A lettering machine, similar to the one used in making sign inserts of interior signages, including white and black vinyl tape for lettering on the reverse black and white sign inserts shall be furnished by the Contractor.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least thickness as indicated, and aluminum plate or sheet shall be at least 1.3 mm thick. Extrusions shall conform to ASTM B 221M ; plate and sheet shall conform to ASTM B 209M . Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown. Welding for aluminum products shall conform to AWS D1.2.

2.5 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Integral color anodized designation AA-M10-C22-A32, Architectural Class II, 0.010 to 0.018 mm.

Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.010 to 0.018 mm.

2.6 FABRICATION AND MANUFACTURE

2.6.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.6.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.7 COLOR, FINISH, AND CONTRAST

In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 75 mm of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown for directories shall include

slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 2 mm thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 0.13 mm green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

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SECTION 10522

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SECTION 10522

FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Manufacturer's Instructions

Fire extinguisher cabinets.

Fire extinguishers.

Submit manufacturer's specifications and installation instructions for each item, including compliance with requirements.

1.2 RECOGNIZED MANUFACTURERS

Products shall be of reputable manufacturers who have been regularly engaged in the productions of the specialties and who issue catalog information on the products. The building specialties shall have been in successful operation for at least one year. The right is reserved to require the manufacturers to submit list of buildings where they have been installed. Colors and patterns listed are not intended to limit selection of similar colors and patterns from other manufacturers.

1.2 DELIVERY, STORAGE AND PROTECTION

Deliver materials to the site in original sealed containers or packages, bearing the manufacturer's name and brand designation. Where materials are covered by a referenced specification, the containers or packages shall bear the specification number, type, and class as applicable. Store and handle material in a manner to protect them from damage during the construction period.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHER CABINETS

2.1.1 Semi-Recessed Mounted Units

Aluminum with dark bronze anodized door and trims and aluminum prefinished box as manufactured by Larsen's Model No. AL2409-6R or approved equal. Door to have tempered safety glass and continuous hinge with chrome handle with cam latch. Unit shall be capable of housing a 4.54 kg (10 pound) 4A:60B:C extinguisher.

2.2 FIRE EXTINGUISHERS

ABC multi-purpose dry chemical extinguisher, 4.54 kg (10 pounds), UL listed, rated 4A:60B:C, hose discharge, 4.57 - 6.40 meters stream range, red gloss polyester coated steel cylinder with pressure gauge as manufactured by Larsen's Model No. MP-10 or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

Install all miscellaneous specialties in conformance with the manufacturer's recommendations and architectural details. Provide extinguishers and cabinets as indicated on the drawings.

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MAILBOXES

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SECTION 10550

MAILBOXES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

UNITED STATES POSTAL SERVICE (USPS)

USPS Publication 17 (1978) Apartment House Mail Receptacles;
Regulations And Manufacturing Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Mailbox Installation.

Drawings showing construction and installation details shall be submitted for approval prior to fabrication of mailboxes.

SD-03 Product Data

Mailboxes, Parcel Lockers, and Mail Collection Boxes.

Manufacturer's printed data, catalogue cuts, installation instructions.

1.3 DELIVERY AND STORAGE

The mailboxes shall be delivered to the job site wrapped in a protective covering. Cabinets shall be stored in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Mailboxes shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 MAILBOXES

Mailboxes shall be USPS approved rear-loading horizontal type mailboxes. Mailboxes, materials, sizes, construction, and installation shall comply with USPS Publication 17, except that the mailboxes shall be provided with combination locks, in lieu of key locks and shall be nine units high. Quantities and arrangement of mailboxes shall be as indicated. Rear loading type horizontal mailboxes shall be equipped with sheet aluminum removable rear covers strengthened with formed sheet stiffeners. Framework supporting compartment doors shall be fabricated from high strength extruded aluminum alloy.

2.1.1 Compartment Construction

Construction shall be double-walled high strength sheet aluminum alloy with vertical stiffeners of form aluminum.

2.1.2 Compartment Doors

Doors shall be fabricated from high strength extruded aluminum alloy, with a minimum of (1/8 inch) thickness, and swing on concealed hinge pins. When closed, the door shall interlock with frame member along hinge side and shall be precision fitted to preclude prying. Doors shall be reinforced vertically along both sides and near center with integral ribs.

2.1.3 Door identification

Each compartment door shall have (1/2 inch) high numbers permanently engraved in face of door. Numbering to be vertically, in sequence, from left to right. Numbering to be furnished to mailbox manufacturer by contracting officer or representative.

2.1.4 Locks

Locks on individual compartment doors shall be a spring latch type, three digit single dial combination lock with automatic throw-off.

2.1.5 Trim

Rear loading mailboxes shall be supplied with snap-on type aluminum trim of matching finish. Snap-on trim to installed at job site.

2.1.6 Sorting Identification

Mailboxes shall be furnished with aluminum channel type cardholders with pressure sensitive backing to accommodate (7/16 inch) by (1-1/2) inch cards. Cards with mailbox identification numbers printed on them shall be provided. Numbering to be furnished to mailbox manufacturer by contracting officer or representative.

2.2 MAIL COLLECTION UNIT

The mail collection unit shall be USPS approved and rear loading. The

height of the collection unit shall be the same as the mailboxes and included within the snap-on trim to form an integral units.

The front plate shall be fabricated of minimum (1/8 inch) thick, high strength aluminum. The frame and mounting angles shall be fabricated of minimum (1/8 inch) thick high strength aluminum. The front plate shall be engraved "U.S. MAIL" in (1 inch) high lettering. Rear cover shall be lift-off type.

2.3 FINISH

Finish on mailbox fronts parcel lockers mail collection unit and associated trim shall be a medium bronze, Duranodic 313E, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

The mailboxes, parcel lockers and collection unit shall be installed level, plumb, and true to line, and shall be attached with suitable devices to securely anchor the mailbox units. Installation shall be in accordance with the manufacturer's printed instructions. Prior to final acceptance, doors shall be aligned, hardware adjusted, and the mailboxes left in a clean neat condition.

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DIVISION 10 - SPECIALTIES

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 - 2.1.2 Finishes
- 2.2 ACCESSORY ITEMS
 - 2.2.1 Mirrors, Glass (MG)
 - 2.2.2 Mirror, Metal (MM)
 - 2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)
 - 2.2.4 Shower Curtain Rods (SCR)
 - 2.2.5 Soap Dispenser (SD)
 - 2.2.6 Towel Bar (TB)
 - 2.2.7 Towel Pin (TP) and Coat Hook (CH)
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SECTION 10800

TOILET ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991; R 1997) Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes
Accessory Items

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Samples

Finishes
Accessory Items

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

SD-07 Certificates

Accessory Items

Submit for each type of accessory specified, attesting that the

items meet the specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Toilet accessories shall be provided as indicated. Porcelain type, tile-wall accessories are specified in Section 09310 CERAMIC TILE. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

Metal	Finish
_____	_____
Stainless steel	No. 4 satin finish

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 Mirrors, Glass (MG)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 6 mm (1/4 inch) thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm (1/4 inch) thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous

without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication. Provide in sizes as indicated on drawings.

2.2.2 Mirror, Metal (MM)

Metal mirror shall be bright polished stainless steel, mirror quality, 0.94 mm minimum thickness, edges turned back 6 mm and recess fitted with tempered hardboard backing, and theft-proof fasteners. Size shall be in accordance with paragraph SCHEDULE.

2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 45 L. Unit shall be fabricated of not less than 0.8 mm stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.4 Shower Curtain Rods (SCR)

Shower curtain rods shall be Type 304 stainless steel 32 mm OD by 1.24 mm minimum straight to meet installation conditions.

2.2.5 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 1.2 L (40 fluid ounces) with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps or lavatory mounted, liquid type consisting of a polyethylene tank with a minimum 1.5L (50 fluids ounces) holding capacity and a 100 mm (4 inch) spout length.

2.2.6 Towel Bar (TB)

Towel bar shall be stainless steel with a minimum thickness of 0.38 mm. Bar shall be minimum 19 mm diameter, or 16 mm square. Finish shall be bright polish.

2.2.7 Towel Pin (TP) and Coat Hook (CH)

Towel pin and coat hook shall have concealed wall fastenings, and a pin and coat hook shall be integral with or permanently fastened to wall flange. Maximum projection shall be 100 mm. Design shall be consistent with design of other accessory items. Finish shall be satin.

2.2.8 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with single roll of standard tissue. Toilet tissue holder shall be stainless steel.

2.2.9 Toilet Seat Cover Dispenser (TSCD)

Toilet seat cover dispensers shall be Type 304 stainless steel and shall be surface mounted. Dispenser shall have a minimum capacity of 500 seat covers.

2.2.10 Porcelain Soap Dish (PSD)

Porcelain soap dish shall be as specified in Section 09310 CERAMIC TILE.

PART 3 EXECUTION

3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Brackets, plates, anchoring devices and similar items used for mounting accessories in showers shall be bedded in a sealant as specified in Section 07900a JOINT SEALING as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

3.3 SCHEDULE

Toilet accessories shall be provided as indicated.

-- End of Section --

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DIVISION 11 - EQUIPMENT

SECTION 11131

PROJECTION SCREEN

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- 1.1 SUMMARY
- 1.2 SUBMITTALS
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- 1.4 FIELD MEASUREMENTS
- 1.5 WARRANTY

PART 2 PRODUCTS

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 - 2.1.1 Vinyl Viewing Surface
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 - 2.1.2.1 Screen
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 - 2.1.3 Case

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 CLEANING
- 3.3 ADJUSTING

-- End of Section Table of Contents --

SECTION 11131

PROJECTION SCREEN

PART 1 GENERAL

1.1 SUMMARY

This section covers motor operated recess mounted front projection screen.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Text explaining details of information to be submitted.

SD-02 Shop Drawings

Projection Screen.

SD-03 Product Data

Projection Screen.

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

Drawings showing fabrication and installation details. Drawings shall show layout and locations of controls, wiring diagrams, mounting heights, and details.

1.3 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area.

1.4 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Vinyl Viewing Surface

Panamax seamless matt white. Viewing surface material shall be flame and mildew resistant.

2.1.2 Front Projection Screen

Motor operated screens shall be 3048 mm by 3048 mm unless indicated otherwise. The complete screen unit shall bear the Underwriters Laboratories, Inc., label.

2.1.2.1 Screen

Screen shall be electrically operated and provided with limit switches to automatically stop screen in "up" and "down" positions. Three position control switch shall stop or reverse screen at any point and be furnished with metal box and stainless steel cover plate.

2.1.2.2 Motor

Motor shall be instantly reversible, designed for the purpose, with lifetime lubrication. Equip motor with automatic thermal overload cut-out and brake to prevent coasting. Gears shall be integral with the motor frame.

2.1.3 Case

Case shall be recessed mounted above the ceiling as indicated with 19 mm thick warp resistant composition wood with prime coat or as indicated on the drawings. Viewing surface shall be mounted on rigid steel roller equipped with ball bearing roller. Provide metal bumper stops, padded with sponge rubber built into case to prevent tubular slat wedging inside the case.

PART 3 EXECUTION

3.1 INSTALLATION

Install screens accurately, in alignment and where shown. Screens shall be level and set parallel to line and plane of surface as shown. Provide anchoring devices and fasteners as shown and as necessary to securing screens to building construction.

3.2 CLEANING

After installation clean all surfaces and protect from damage until completion of the project. Viewing surfaces shall be cleaned only in accordance with the manufacturer's instructions.

3.3 ADJUSTING

Movable parts shall be cleaned and adjusted to operated as designed without binding or deformation of any part. Motor controls shall be verified to insure operation as specified.

-- End of Section --

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DIVISION 12 - FURNISHINGS

SECTION 12320A

CABINETS AND COUNTERTOPS

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- 1.1 REFERENCES
- 1.2 DESIGN
- 1.3 SUBMITTALS
- 1.4 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 CABINETS
 - 2.1.1 Frame Type Cabinets
- 2.2 COUNTERTOPS AND BACKSPLASH
 - 2.2.1 High-Pressure Laminated Plastic Clad Countertops
 - 2.2.2 Solid Polymer Countertops
- 2.3 Sink/Lavatory Rims
- 2.4 FINISH
 - 2.4.1 Cabinet Finish
 - 2.4.2 Melamine Laminated Interior Cabinet Finish
 - 2.4.3 Backer Sheets
- 2.5 HARDWARE
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SECTION 12320A

CABINETS AND COUNTERTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 570	(1995) Water Absorption of Plastics
ASTM D 638	(1997) Tensile Properties of Plastics
ASTM D 2583	(1995) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	(1997a) Surface Burning Characteristics of Building Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(1994) Cabinet Hardware
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KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1	(1995) Performance & Construction Standards for Kitchen and Vanity Cabinets
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
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1.2 DESIGN

Cabinets shall be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position

stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan, location, and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and attachments.

SD-03 Product Data

Cabinets Countertops and Backsplash

Manufacturer's printed data, catalog cuts, installation and cleaning instructions.

SD-04 Samples

Cabinets Countertops and Backsplash

In lieu of individual samples, complete minimum size cabinets may be furnished as samples. Mock-up units are not acceptable. Samples shall be of sufficient size to show color, pattern, and method of assembly.

- a. Countertop and backsplash - One section, containing both.
- b. Door and drawer front - One of each, with hardware mounted.
- c. Countertop color samples approximately 50 x 75 mm size.
- d. Color samples approximately 50 x 75 mm size.

SD-06 Test Reports

Cabinets and Countertops

Test reports certifying that all cabinets comply with the requirements of KCMA A161.1. Tests shall be conducted by independent laboratories approved by KCMA. KCMA certification seals affixed to the cabinets will be accepted in lieu of

certified test reports.

1.4 DELIVERY AND STORAGE

Cabinets shall be delivered to the jobsite wrapped in a protective covering. Cabinets shall be stored in accordance with manufacturer's recommendations in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be solid flush face from vendors standard styles. Shelves shall be fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 75 mm increments. Shelves shall be supported by self-locking clips. Clips (shelf rests) shall be B04091 with B04071 mortised shelf standards. Shelves shall be 19 mm thick plywood. Drawer fronts shall be hardwood plywood to match cabinet door construction.

2.1.1 Frame Type Cabinets

The cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 19 mm thick by 38 mm wide; kiln-dried hardwood, glued together, and shall be either mortised and tenoned, dovetailed or doweled, nailed, stapled or screwed. Top and bottom corners shall be braced with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of base and tall cabinets shall be 9 mm thick hardwood or hardboard as indicated. Bottoms of cabinets shall be minimum 19 mm thick plywood or good grade plywood and shall be braced with wood members glued in place. Cabinet ends shall be 19 mm thick hardwood plywood.

2.2 COUNTERTOPS AND BACKSPLASH

2.2.1 High-Pressure Laminated Plastic Clad Countertops

Clad countertop and backsplash shall be constructed of 19 mm thick plywood and shall be post formed cove type or fully formed type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Fully formed type or square edge shall be a unit with shaped edges using wood nose molding at counter edge and shall include a separate backsplash. Backsplash shall be not less than 90 mm high. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 19 mm. Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, GP50 plastic laminate shall be used. When the countertop and backsplash are one

unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

2.2.2 Solid Polymer Countertops

Countertop and backsplash shall be constructed as shown. Material thickness shall be as indicated, cast, and filled nonporous solid surfacing composed of acrylic polymer, mineral fillers, and pigments. Superficial damage to a depth of 0.25 mm shall be repairable by sanding or polishing. Material shall comply with the following performance requirements.

- a. Tensile Strength; 18.3 N/mm^2 , when tested in accordance with ASTM D 638.
- b. Hardness; Barcol Impressor 50 when tested in accordance with ASTM D 2583.
- c. Flammability; rated Class I with a flame spread of 25 maximum and a smoke developed of 100 maximum when tested in accordance with ASTM E 84.
- d. Boiling water resistance; no effect when tested in accordance with NEMA LD 3.
- e. High temperature; no effect when tested in accordance with NEMA LD 3.
- f. Liquid absorption; 0.06% maximum (24 hours) when tested in accordance with ASTM D 570.
- g. Sanitation; National Sanitation Foundation approval for food contact in accordance with Standard 51 and approval for food area applications.
- h. Impact resistance; no failure for ball drop when tested in accordance with NEMA LD 3.

2.3 Sink/Lavatory Rims

Sink/lavatory rims shall be of the corrosion resistant steel clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

2.4 FINISH

2.4.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish in accordance with KCMA A161.1 requirements and of a type standard with the manufacturer. Exposed exterior surfaces shall be melamine plastic finish.

2.4.2 Melamine Laminated Interior Cabinet Finish

Plywood or tempered hardboard cabinet backs shall be finished with a melamine laminate on the exposed side. Shelves shall be covered on both sides and exposed edges with a laminated melamine finish. Melamine laminate shall conform to the requirements of NEMA LD 3 CL20 and laminate adhesive shall be contact type.

2.4.3 Backer Sheets

Backer Sheets of high pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material.

2.5 HARDWARE

Hardware shall conform to BHMA A156.9, shall be suitable for cabinet use, and shall include all miscellaneous hardware for a complete installation. Drawer runners shall have nylon rollers standard with the manufacturer. The types and finishes of hardware shall be as indicated on the drawings.

2.6 COLOR, TEXTURE, AND PATTERN

Design, color, and finish shall be as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated on the drawings. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cut-outs in laminated plastic tops shall be painted with a coat of semigloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required. Prior to final acceptance, doors shall be aligned, and hardware shall be adjusted.

3.2 CLEANING

Cabinet and countertop surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

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DIVISION 12 - FURNISHINGS

SECTION 12490A

WINDOW TREATMENT

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PART 3 EXECUTION

- 3.1 INSTALLATION

-- End of Section Table of Contents --

SECTION 12490A

WINDOW TREATMENT

PART 1 WORK DESCRIPTION

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing fabrication and installation details. Drawings shall show layout and locations of track, mounting heights, and details.

SD-03 Product Data

Window Treatments
Hardware

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Treatments

Three samples of each type and color of window treatment. Blind slats shall be 150 mm in length for each color. Track shall be 150 mm in length. Shade material shall be minimum 150 x 150 mm in size.

1.2 GENERAL

Window treatment shall be provided, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit. Equipment shall be mounted and operated as indicated. Windows to receive a treatment shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper fitting and hanging of the equipment.

1.3 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area.

1.4 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Each blind, including hardware, accessory items, mounting brackets and fastenings, shall be provided as a complete unit produced by one manufacturer. All parts shall be one color unless otherwise shown, and match the color of the blind slat. Steel features shall be treated for corrosion resistance.

2.1.1 Vertical Blinds

Vertical blind units shall be capable of nominally 180 degree partial tilting operation and full stackback. The blinds shall be listed by the manufacturer as designed for heavy duty strength applications including heavy duty hardware. Vertical blinds shall be mounted with inside brackets as shown. Blinds shall be sill length. Outside mount type installation shall provide adequate overlap to control light and privacy.

2.1.1.1 Louvers

Fabric louvers shall be inherently flame retardant. The louvers shall have straight, flat, unfrayed edges and shall be flat, without noticeable twists. A weight shall be provided at the bottom of the louver. The insert shall not discolor the fabric. Louvers shall not have a bottom chain. Fabric louvers shall be flame retardant and colorfast 88.9 mm (3-1/2 inch) louvers shall overlap not less than 10 mm and shall be dimensionally stable.

2.1.1.2 Carriers

Carriers shall be provided to support each louver. Carriers shall be of molded plastic and shall transverse on self-fabricated wheels for smooth, easy operation. The hook of the carrier shall have an automatic latch to permit easy installation and removing of the louver, and shall securely lock the louver for tilting and traversing.

2.1.1.3 Headrail System

Headrail system shall be not less than 1.19 mm thickness and shall be made of anodized aluminum alloy or 0.635 mm thick phosphate treated steel with a baked on ivory gloss enamel paint finish. The headrail shall extend the full width of the blind and each end shall be closed with an end cap. One cap shall contain the traversing and tilting controls. The opposite cap shall house the pulley for the traversing cord.

2.1.1.4 Cornice, Fascia, or Valance

Manufacturers standard valance shall be attached to the headrail by metal holders which grip the top and bottom edge of the valance and shall accept an insert of the same material as the slats. There shall be sufficient clearance behind the valance to permit the louvers to tilt without interference. The headrail cover shall extend the full width of the blind. Returns shall be formed of a single piece where the end of the head is visible.

2.1.1.5 Controls

Tilting control and traversing controls shall hang compactly at the right side of the blinds and shall reach within 1500 mm of the floor. The tilt/traverse control baton shall tilt all vanes simultaneously to any desired angle and hold them at that angle. The louvers shall traverse one way to the left. A fiberglass wand shall tilt the louvers by turning the wand and shall traverse the louvers by using the wand as a drapery baton.

2.1.1.6 Connectors and Spacers

The connector shall be flexible, smooth and flat to slide unhindered when carriers move independently of each other, and to nest compactly when carriers are stacking. The length of the links shall relate to the louver width in order to equally space the traversing louvers, to maintain uniform and adequate overlap of louvers, and to fully cover the width of the opening.

2.1.1.7 Intermediate Brackets

Intermediate installation brackets shall be furnished for blinds over 1575 mm wide.

2.2 COLOR

Color shall be as scheduled.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the approved detail drawings and manufacturer's installation instructions. Units shall be level, plumb, secure, and at proper height and location relative to window units. The

Contractor shall furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation shall not be initiated until completion of room painting and finishing operations. Upon completion of the installation, window treatments shall be adjusted for form and appearance, shall be in proper operating condition, and shall be free from damage or blemishes. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

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SECTION 13080

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SECTION 13080

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996) Strength of Anchors in Concrete and Masonry Elements
ASTM E 580	(1991) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
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ASME B18.2.2 (1987; R 1999) Square and Hex Nuts (Inch Series)

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-12 (1991; Appx E, 1993) Seismic Restraint Manual Guidelines for Mechanical Systems

UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995) Fluorescent Lighting Fixtures

UL 1571 (1991; Rev thru Mar 95) Incandescent Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems outlined in Section 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. Seismic protection requirements shall be in accordance with ICB using an importance factor of IV and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group I building occupancy and on site response coefficients for $S_{MS} = 0.79$ and $S_{M1} = 0.37$. This facility shall be designed as being in seismic zone 2A; no other zone value shall be used to establish bracing requirements. Lateral support against earthquake induced forces shall be accomplished by positive attachments without consideration of friction resulting from gravity loads.

1.2.2 Mechanical/Electrical Equipment

Mechanical/electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

- | | |
|------------------------------|---------------------------------|
| Boilers and furnaces | Storage Tanks for Oil and Water |
| Water Heaters | Water and Gas Piping |
| Heat Exchangers | Cable Trays |
| Control Panels | Refrigerant Compressors |
| Pumps with Motors | Air Handling Units |
| Light Fixtures | Switchgear |
| Motor Control Centers | Transformers |
| Switchboards (Floor Mounted) | Ducts |
| Suspended Ceiling Assemblies | Exhaust and Return Fans |
| | Fan Coil Units |
| | Reheat Coils |

1.2.3 Mechanical/Electrical Systems

The following mechanical and electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building in Accordance With This Specification
 All Water Supply Systems
 Storm and Sanitary Sewer Systems

1.2.4 Exclusion

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 13930A WET PIPE SPRINKLER SYSTEM.

1.2.5 Pipes and Ducts Requiring No Special Seismic Restraints

Seismic restraints may be omitted from the following installations:

- a. Gas piping less than 25 mm (1 inch) inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than 32 mm (1-1/4 inches) inside diameter.
- c. All other piping less than 38 mm (1-1/2 inches) inside diameter.
- d. Electrical conduit less than 64 mm (2-1/2 inches) inside diameter.
- e. Rectangular air handling ducts less than 0.37 square meters (4 square feet) in cross sectional area.
- f. Round air handling ducts less than 457 mm (18 inches) in diameter.
- g. Piping suspended by individual hangers 300 mm or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- h. Ducts suspended by hangers 300 mm or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions g. and h. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced.

1.2.6 All Other Interior Piping, Conduit, and Ducts

Interior piping, conduit, and ducts not covered by paragraphs Exclusion or Pipes and Ducts Requiring No special Seismic Restraints shall be seismically protected in accordance with the provisions herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing and Coupling
Resilient Vibration Isolation Devices
Equipment Requirements

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Bracing and Coupling
Equipment Requirements

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

2.2 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36/A 36M.
- b. Wire rope, ASTM A 603.
- c. Tubes, ASTM A 500, Grade B.
- d. Pipes, ASTM A 53, Type S, Grade B.
- e. Light gauge angles, less than 6 mm thickness, ASTM A 653/A 653M.

2.3 Flexible Couplings

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe specified in section 15400A PLUMBING, GENERAL PURPOSE.

2.3.1 Flexible Ball Joints

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement.

2.3.2 Flexible Mechanical Joints

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.

2.4 Lighting Fixture Supports

Fixture supports shall be malleable iron. Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

PART 3 EXECUTION

3.1 BRACING

Bracing and coupling shall conform to the arrangements shown. Provisions of this paragraph apply to all piping within a 1.5 m line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 13 mm (1/2 inch) bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Sway braces for a piece of equipment or a run of duct or pipe shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Joints capable of accommodating seismic displacements shall be

provided where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, swing joints shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 meters per meter of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 90 mm (3-1/2 inches) in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

3.3.2 Underground Piping

Underground piping and 100 mm (4 inch) or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 25 mm of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 100 mm apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 ANCHOR BOLTS

3.6.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except

as specified below. One nut shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.6.2 Minimum Bolt Sizes, Cast-In-Place Anchor Bolts

Maximum Equipment Weight (Kg)	Minimum Bolt Sizes (mm)*
	Zone 2A
225	13
450	13
2250	13
4500	13
9000	13
13500	13
22500	13
45000	16

*Based on four bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Equivalent total cross-sectional area shall be used when more than four bolts per item are provided. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt.

3.6.3 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.6.3.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.6.3.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 25 percent of the total installed expansion anchors and at least one anchor for every piece

of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 9 mm sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 10 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.6.3.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 10 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.7 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.7.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 13 mm.

3.7.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or slab-mounted equipment. These snubbers shall provide 6 mm free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.8 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 50 x 50 mm x 16 gauge and one diagonal angle of the same size.

3.8.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 15070ASEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

3.8.2 Vertical Runs

Vertical runs of piping shall be braced at not more than 3 m (10 ft) vertical intervals. For tubing, bracing shall be provided at no more than 1.2 m spacing. Vertical braces shall be above the center of gravity of the span being braced. All sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.8.3 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.8.4 Maximum Length for Anchor Braces

Type	Size (millimeters)	Maximum Length* (meters)
Angles	38 x 38 x 6	1.5
	50 x 50 x 6	2.0
	64 x 38 x 6	2.5
	75 x 64 x 6	2.5
	75 x 75 x 6	3.0
Rods	91	1.0
	22	1.0
Flat Bars	38 x 6	0.4
	50 x 6	0.4
	50 x 10	0.5
Pipes (40s)	25	2.0
	32	2.8

Type	Size (millimeters)	Maximum Length* (meters)
	40	3.2
	50	4.0

* Based on the slenderness ratio of $l/r=200$ and ASTM A 36/A 36M steel, where l is the length of the brace and r is the least of gyration of the brace.

3.8.5 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.8.6 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm (1/2 inch) diameter.

3.9 SWAY BRACES FOR DUCTS

3.9.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA-12, including Appendix E, using Seismic Hazard Level C.

3.9.2 Unbraced Ducts

Hangers for unbraced ducts shall be positively attached to the duct within 50 mm of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 150 mm minimum clearance to vertical ceiling hanger wires.

3.10 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe.

3.11 EQUIPMENT SWAY BRACING

3.11.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 13 mm bolts. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 0.56 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for

acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.11.2 Floor or Pad Mounted Equipment

3.11.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.11.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

3.12 MISCELLANEOUS EQUIPMENT

3.12.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand a horizontal lateral force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

Rigidly Mounted Equipment

- Water Heater
- Boilers
- Air-Handling Units
- Transformers
- Switch Boards and Switch Gears
- Motor Control Centers
- Free Standing Electric Motors
- Water Storage Tanks
- Heat Exchangers

3.12.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 2 times the operating weight of the equipment at the vertical center of gravity of the equipment. Air Handling Units, Fan Coil Units, Reheat Coils.

3.13 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.13.1 Pendant Fixtures

Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

3.13.2 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be fastened thereto at each corner of the fixture with bolts or approved clips; or shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures, attached to opposite corners, and one wire per unit of continuous row mounted fixtures. Each wire support shall be capable of supporting four times the weight of the fixture. Recessed lighting fixtures not over 25 kg in weight and suspended or pendant-hung fixtures not over 10 kg in weight may be supported by and attached directly to the ceiling system runners by a positive attachment such as screws or bolts, number and size as required by design seismic zone.

3.13.3 Assembly Mounted on Outlet Box

A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 100 mm boxes, 75 mm plaster rings, and fixture studs.

3.13.4 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.

3.13.5 Wall-Mounted Emergency Light Unit

Each wall-mounted emergency light unit shall be secured to remain in place during a seismic disturbance.

3.13.6 Lateral Force

Light fixture bracing shall be designed to resist a lateral force of 0.56 times the fixture weight.

3.14 SUSPENDED CEILING ASSEMBLIES

The structural members of ceiling support systems, used primarily to support acoustical tile panels or acoustical panel lay-in tiles, with or without lighting fixtures, ceiling-mounted air terminals, and ceiling-mounted services, shall conform to the following:

3.14.1 Design Loads

The main runners and cross-runners and their splices and intersection connections shall be designed for two times the design load or ultimate axial tension or compression (minimum 550 N (120 pounds).) The connections at the splices and intersections shall be of a mechanical interlocking type that cannot easily be disengaged. Ceiling structural systems shall be designed to withstand required vertical load as well as a lateral force of 11.3 percent of the ceiling weight. The ceiling weight shall include all lighting fixtures and other equipment that are laterally supported by the ceiling and shall be not less than 200 Pa (4.0 psf). Exception: Ceiling areas of 13 square meters or less surrounded by walls that connect directly to the structure above will be exempt from the lateral-load standards of this specification.

3.14.2 Installation Requirements

Installation requirements shall be in accordance with ASTM E 580 except as follows:

3.14.2.1 Vertical Support

Hanger wires supporting a maximum tributary ceiling area of 1.5 square meters shall be a minimum of 10 gauge in diameter. The size of wires supporting a tributary ceiling area greater than 1.5 square meters shall be substantiated by design calculations. Hanger attachment devices used in ceiling systems not exceeding 200 Pa shall be capable of supporting a minimum allowable load of 1.3 kN (300 pounds). Hanger attachment devices used in ceiling systems exceeding 200 Pa shall be capable of supporting the design load and shall be substantiated by design calculations. If hangers must be splayed more than one horizontal to six vertical, the resulting horizontal force shall be offset by bracing or counter-splaying, and substantiated by design calculations.

3.14.2.2 Lateral Support

In lieu of the design criteria stated above, where ceiling loads do not exceed 200 Pa, lateral support for the ceiling system may be provided by four galvanized wires of minimum No. 12 gauge, as indicated in ASTM E 580, paragraph 4.4.6.

3.14.3 Lighting Fixture and Air Diffuser Supports

Lighting fixture and air diffuser supports shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:

- a. Recessed lighting fixtures not over 25 kg in weight and suspended and pendent-hung fixtures not over 10 kg in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.
- b. Air diffusers that weigh not more than 10 kg and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

-- End of Section --

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SECTION 13100A

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SECTION 13100A

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 780 (1997) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96 (1994; Rev thru Jan 2000) Lightning Protection Components

UL 96A (1994; Rev thr Jul 1998) Installation Requirements for Lightning Protection Systems

UL 467 (1993; Rev thru Apr 1999) Grounding and Bonding Equipment

UL Elec Const Dir (1999) Electrical Construction EquipmentDirectory

1.2 GENERAL REQUIREMENTS

1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

SD-07 Certificates

Materials

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL Elec Const Dir will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection systems provided on the following facilities: Fences crossed by overhead electrical lines in excess of 600V as described herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be

increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

2.1.2.1 Copper

Copper conductors shall weigh not less than 170 kg per 300 m (375 pounds per thousand feet), and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG.

2.1.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, strips that are much wider than solid strips shall be. A strip width that is at least twice that of the diameter of the perforations shall be used. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 38.1 mm wide.

2.1.3 Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to ANSI C135.30. Ground rods shall be not less than 19.1 mm (3/4 inch) in diameter and 3.048 m (10 feet) in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

2.1.4 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation.

2.1.5 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

3.1.1 General Requirements

The lightning protection system shall consist of ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves.

3.1.1.1 Down Conductors

Down conductors shall be electrically continuous from the fence connections to grounding electrodes. Each structure shall have not less than two down conductors located as widely separated as practicable.

3.1.1.2 Ground Connections

Ground connections comprising continuations of down conductors from the fence to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.1.3 Grounding Electrodes

A grounding electrode shall be provided for each down conductor. A driven ground shall extend into the earth for a distance of not less than 3.0 meters. The complete installation shall have a total resistance to ground of not more than 25 ohms. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 25 ohms, the Contracting Officer shall be notified immediately. All connections between ground connectors, and between grounds shall be electrically continuous.

3.2 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 600 mm into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 300 to 450 m of length when fences are located in isolated places, and every 150 to 225 m when in proximity (30 m or less) to public roads, highways, and buildings. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 45 m on each side of line crossings.

3.3 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

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SECTION 13280A

ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z87.1	(1989; Errata; Z87.1a) Occupational and Educational Eye and Face Protection
ANSI Z88.2	(1992) Respiratory Protection
ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 1368	(2000) Visual Inspection of Asbestos Abatement Projects
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7	(1990) Compressed Air for Human Respiration
CGA G-7.1	(1997) Commodity Specification for Air

HAWAII ADMINISTRATIVE RULES (HAR)

HAR Chapter 501	Asbestos Requirement
HAR Chapter 502	Asbestos Containing Materials in Schools
HAR Chapter 503	Fees for Asbestos Removal & Certification
HAR Chapter 504	Asbestos Abatement Certification Program

HAWAII STATE OCCUPATIONAL SAFETY AND HEALTH (HIOSH)

HIOSH 12-145	Asbestos
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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 84-100	(1984; Supple 1985, 1987, 1988 & 1990) NIOSH Manual of Analytical Methods
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U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 340/1-90/018	(1990) Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance
EPA 340/1-90/019	(1990) Asbestos/NESHAP Adequately Wet Guidance
EPA 560/5-85-024	(1985) Guidance for Controlling Asbestos-Containing Materials in Buildings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 763	Asbestos
42 CFR 84	Approval of Respiratory Protective Devices
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special

Provisions, Hazardous Materials
 Communications, Emergency Response
 Information, and Training Requirements

49 CFR 173

Shippers - General Requirements for
 Shipments and Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586

(1996; Rev thru Aug 1999) High-Efficiency,
 Particulate, Air Filter Units

1.2 DEFINITIONS

- a. Adequately Wet: A term defined in 40 CFR 61, Subpart M, and EPA 340/1-90/019 meaning to sufficiently mix or penetrate with liquid to prevent the release of particulate. If visible emissions are observed coming from asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wetted.
- b. Aggressive Method: Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact asbestos-containing material (ACM).
- c. Amended Water: Water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter when tested in accordance with ASTM D 1331.
- d. Asbestos: Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.
- e. Asbestos-Containing Material (ACM): Any materials containing more than one percent asbestos.
- f. Asbestos Fiber: A particulate form of asbestos, 5 micrometers or longer, with a length-to-width ratio of at least 3 to 1.
- g. Authorized Person: Any person authorized by the Contractor and required by work duties to be present in the regulated areas.
- h. Building Inspector: Individual who inspects buildings for asbestos and has EPA Model Accreditation Plan (MAP) "Building Inspector" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.
- i. Certified Industrial Hygienist (CIH): An Industrial Hygienist certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.

- j. Class I Asbestos Work: Activities defined by OSHA involving the removal of thermal system insulation (TSI) and surfacing ACM.
- k. Class II Asbestos Work: Activities defined by OSHA involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos - containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic. Certain "incidental" roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work. Removal of small amounts of these materials which would fit into a glovebag may be classified as a Class III job.
- l. Class III Asbestos Work: Activities defined by OSHA that involve repair and maintenance operations, where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.
- m. Class IV Asbestos Work: Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean-up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction.
- n. Clean room: An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.
- o. Competent Person: In addition to the definition in 29 CFR 1926, Section .32(f), a person who is capable of identifying existing asbestos hazards as defined in 29 CFR 1926, Section .1101, selecting the appropriate control strategy, has the authority to take prompt corrective measures to eliminate them and has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.
- p. Contractor/Supervisor: Individual who supervises asbestos abatement work and has EPA Model Accreditation Plan "Contractor/Supervisor" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.
- q. Critical Barrier: One or more layers of plastic sealed over all openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.
- r. Decontamination Area: An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of

workers, materials, and equipment that are contaminated with asbestos.

- s. Demolition: The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.
- t. Disposal Bag: A 0.15 mm thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926, Section .1101, used for transporting asbestos waste from containment to disposal site.
- u. Disturbance: Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in 1 standard sized glovebag or waste bag, not larger than 1.5 m in length and width in order to access a building component.
- v. Equipment Room or Area: An area adjacent to the regulated area used for the decontamination of employees and their equipment.
- w. Employee Exposure: That exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.
- x. Fiber: A fibrous particulate, 5 micrometers or longer, with a length to width ratio of at least 3 to 1.
- y. Friable ACM: A term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. If the asbestos content is less than 10 percent, as determined by a method other than point counting by PLM, the asbestos content is verified by point counting using PLM.
- z. Glovebag: Not more than a 1.5 by 1.5 m impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.
- aa. High-Efficiency Particulate Air (HEPA) Filter: A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.
- bb. Homogeneous Area: An area of surfacing material or thermal system insulation that is uniform in color and texture.
- cc. Industrial Hygienist: A professional qualified by education, training, and experience to anticipate, recognize, evaluate, and develop controls for occupational health hazards.

- dd. Intact: ACM which has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Removal of "intact" asphaltic, resinous, cementitious products does not render the ACM non-intact simply by being separated into smaller pieces.
- ee. Model Accreditation Plan (MAP): USEPA training accreditation requirements for persons who work with asbestos as specified in 40 CFR 763, Subpart E, Appendix C.
- ff. Modification: A changed or altered procedure, material or component of a control system, which replaces a procedure, material or component of a required system.
- gg. Negative Exposure Assessment: A demonstration by the Contractor to show that employee exposure during an operation is expected to be consistently below the OSHA Permissible Exposure Limits (PELs).
- hh. NESHAP: National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61, Subpart M.
- ii. Nonfriable ACM: A NESHAP term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material containing more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy, that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.
- jj. Nonfriable ACM (Category I): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy.
- kk. Nonfriable ACM (Category II): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos, as determined using the methods specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
- ll. Permissible Exposure Limits (PELs):
- (1) PEL-Time weighted average(TWA): Concentration of asbestos not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8 hour time weighted average (TWA), as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH Pub No. 84-100 analytical method 7400.
- (2) PEL-Excursion Limit: An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling

period of 30 minutes as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH Pub No. 84-100 analytical method 7400.

- mm. Regulated Area: An OSHA term defined in 29 CFR 1926, Section .1101 meaning an area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted; also any adjoining area where debris and waste from such asbestos work accumulate; and an area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.
- nn. Removal: All operations where ACM is taken out or stripped from structures or substrates, and includes demolition operations.
- oo. Spills/Emergency Cleanups: Cleanup of sizable amounts of asbestos waste and debris which has occurred, for example, when water damage occurs in a building, and sizable amounts of ACM are dislodged. A Competent Person evaluates the site and ACM to be handled, and based on the type, condition and extent of the dislodged material, classifies the cleanup as Class I, II, or III. Only if the material was intact and the cleanup involves mere contact of ACM, rather than disturbance, could there be a Class IV classification.
- pp. Surfacing ACM: Asbestos-containing material which contains more than 1% asbestos and is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.
- qq. Thermal system insulation (TSI) ACM: ACM which contains more than 1% asbestos and is applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain or water condensation.
- rr. Transite: A generic name for asbestos cement wallboard and pipe.
- ss. Worker: Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos worker training required by 29 CFR 1926, Section .1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation required by 40 CFR 763, Subpart E, Appendix C, if required by the OSHA Class of work to be performed or by the state where the work is to be performed.

1.3 DESCRIPTION OF WORK

The work covered by this section includes the removal of asbestos-containing materials (ACM) which are encountered during demolition activities associated with this project and describes procedures and equipment required to protect workers and occupants of the regulated area from contact with airborne asbestos fibers and ACM dust and debris. Activities include OSHA Class I and Class II work operations involving ACM.

The work also includes containment, storage, transportation and disposal of the generated ACM wastes. More specific operational procedures shall be detailed in the required Accident Prevention Plan and its subcomponents, the Asbestos Hazard Abatement Plan and Activity Hazard Analyses required in paragraph SAFETY AND HEALTH PROGRAM AND PLANS.

1.3.1 Abatement Work Tasks

The specific ACM to be abated is identified on the detailed plans and project drawings. A summary of work task data elements for each individual ACM abatement work task to include the appropriate RESPONSE ACTION DETAIL SHEET (item to be abated and methods to be used) and SET-UP DETAIL SHEETS (containment techniques to include safety precautions and methods) is included in Table 1, "Individual Work Task Data Elements" at the end of this section.

1.3.2 Unexpected Discovery of Asbestos

For any previously untested building components suspected to contain asbestos and located in areas impacted by the work, the Contractor shall notify the Contracting Officer (CO) who will have the option of ordering up to 10 bulk samples to be obtained at the Contractor's expense and delivered to a laboratory accredited under the National Institute of Standards and Technology (NIST) "National Voluntary Laboratory Accreditation Program (NVLAP)" and analyzed by PLM at no additional cost to the Government. Any additional components identified as ACM that have been approved by the Contracting Officer for removal shall be removed by the Contractor and will be paid for by an equitable adjustment to the contract price under the CONTRACT CLAUSE titled "changes". Sampling activities undertaken to determine the presence of additional ACM shall be conducted by personnel who have successfully completed the EPA Model Accreditation Plan (MAP) "Building Inspector" training course required by 40 CFR 763, Subpart E, Appendix C.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Respiratory Protection Program; G

Records of the respirator program.

Cleanup and Disposal; G

Waste shipment records. Weigh bills and delivery tickets shall be furnished for information only.

Detailed Drawings; G

Descriptions, detail project drawings, and site layout to include worksite containment area techniques as prescribed on applicable SET-UP DETAIL SHEETS, local exhaust ventilation system locations, decontamination units and load-out units, other temporary waste storage facility, access tunnels, location of temporary utilities (electrical, water, sewer) and boundaries of each regulated area.

Materials and Equipment; G

Manufacturer's catalog data for all materials and equipment to be used in the work, including brand name, model, capacity, performance characteristics and any other pertinent information. Test results and certificates from the manufacturer of encapsulants substantiating compliance with performance requirements of this specification. Material Safety Data Sheets for all chemicals to be used onsite in the same format as implemented in the Contractor's HAZARD COMMUNICATION PROGRAM. Data shall include, but shall not be limited to, the following items:

- a. High Efficiency Filtered Air (HEPA) local exhaust equipment
- b. Vacuum cleaning equipment
- c. Pressure differential monitor for HEPA local exhaust equipment
- d. Air monitoring equipment
- e. Respirators
- f. Personal protective clothing and equipment
 - (1) Coveralls
 - (2) Other work clothing
 - (3) Foot coverings
 - (4) Hard hats
 - (5) Eye protection
 - (6) Other items required and approved by Contractors Designated IH and Competent Person
- g. Glovebag
- h. Duct Tape
- i. Disposal Containers
 - (1) Disposal bags
- j. Sheet Plastic
 - (1) Polyethylene Sheet - General

- k. Wetting Agent
 - (1) Amended Water
 - (2) Removal encapsulant
- l. Strippable Coating
- m. Prefabricated Decontamination Unit
- n. Other items
- o. Chemical encapsulant
- p. Material Safety Data Sheets (for all chemicals proposed)

Qualifications; G

A written report providing evidence of qualifications for personnel, facilities and equipment assigned to the work.

Training Program; G

A copy of the written project site-specific training material as indicated in 29 CFR 1926, Section .1101 that will be used to train onsite employees. The training document shall be signed by the Contractor's Designated IH and Competent Person.

Medical Requirements; G

Physician's written opinion.

Encapsulants; G

Certificates stating that encapsulants meet the applicable specified performance requirements.

SD-06 Test Reports

Exposure Assessment and Air Monitoring; G

Initial exposure assessments, negative exposure assessments, air-monitoring results and documentation.

Local Exhaust Ventilation

Pressure differential recordings.

Licenses, Permits and Notifications; G

Licenses, permits, and notifications.

SD-07 Certificates

Vacuum, Filtration and Ventilation Equipment; G

Manufacturer's certifications showing compliance with ANSI Z9.2 for:

- a. Vacuums.
- b. Water filtration equipment.
- c. Ventilation equipment.
- d. Other equipment required to contain airborne asbestos fibers.

1.5 QUALIFICATIONS

1.5.1 Written Qualifications and Organization Report

The Contractor shall furnish a written qualifications and organization report providing evidence of qualifications of the Contractor, Contractor's Project Supervisor, Designated Competent Person, supervisors and workers; Designated IH (person assigned to project and firm name); independent testing laboratory (including name of firm, principal, and analysts who will perform analyses); all subcontractors to be used including disposal transportation and disposal facility firms, subcontractor supervisors, subcontractor workers; and any others assigned to perform asbestos abatement and support activities. The report shall include an organization chart showing the Contractor's staff organization for this project by name and title, chain of command and reporting relationship with all subcontractors. The report shall be signed by the Contractor, the Contractor's onsite project manager, Designated Competent Person, Designated IH, designated testing laboratory and the principals of all subcontractors to be used. The Contractor shall include the following statement in the report: "By signing this report I certify that the personnel I am responsible for during the course of this project fully understand the contents of 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and the federal, state and local requirements specified in paragraph SAFETY AND HEALTH PROGRAM AND PLANS for those asbestos abatement activities that they will be involved in."

1.5.2 Specific Requirements

The Contractor shall designate in writing, personnel meeting the following qualifications:

- a. Designated Competent Person: The name, address, telephone number, and resume of the Contractor's Designated Competent Person shall be provided. Evidence that the full-time Designated Competent Person is qualified in accordance with 29 CFR 1926, Sections .32 and .1101, has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and is experienced in the administration and supervision of asbestos abatement projects, including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up

and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite, etc. The duties of the Competent Person shall include the following: controlling entry to and exit from the regulated area; supervising any employee exposure monitoring required by 29 CFR 1926, Section .1101; ensuring that all employees working within a regulated area wear the appropriate personal protective equipment (PPE), are trained in the use of appropriate methods of exposure control, and use the hygiene facilities and decontamination procedures specified; and ensuring that engineering controls in use are in proper operating conditions and are functioning properly. The Designated Competent Person shall be responsible for compliance with applicable federal, state and local requirements, the Contractor's Accident Prevention Plan and Asbestos Hazard Abatement Plan. The Designated Competent Person shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that this person has a minimum of 2 years of on-the-job asbestos abatement experience relevant to OSHA competent person requirements. The Designated Competent Person shall be onsite at all times during the conduct of this project.

- b. Project and Other Supervisors: The Contractor shall provide the name, address, telephone number, and resume of the Project Supervisor and other supervisors who have responsibility to implement the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan and Activity Hazard Analyses, the authority to direct work performed under this contract and verify compliance, and have EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C. The Project Supervisor and other supervisors shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that the Project Supervisor has a minimum of 2 years of on-the-job asbestos abatement experience relevant to project supervisor responsibilities and the other supervisors have a minimum of 2 years on-the-job asbestos abatement experience commensurate with the responsibilities they will have on this project.
- c. Designated Industrial Hygienist: The Contractor shall provide the name, address, telephone number, resume and other information specified below for the Industrial Hygienist (IH) selected to prepare the Contractor's Asbestos Hazard Abatement Plan, prepare and perform training, direct air monitoring and assist the Contractor's Competent Person in implementing and ensuring that

safety and health requirements are complied with during the performance of all required work. The Designated IH shall be a person who is board certified in the practice of industrial hygiene or board eligible (meets all education and experience requirements) as determined and documented by the American Board of Industrial Hygiene (ABIH), has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and has a minimum of 2 years of comprehensive experience in planning and overseeing asbestos abatement activities. The Designated IH shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Designated IH shall be completely independent from the Contractor according to federal, state, or local regulations; that is, shall not be a Contractor's employee or be an employee or principal of a firm in a business relationship with the Contractor negating such independent status. A copy of the Designated IH's current valid ABIH certification, confirmation of eligibility in writing from the ABIH shall be included. The Designated IH shall visit the site at least 1 per week for the duration of asbestos activities and shall be available for emergencies. In addition, the Designated IH shall prepare, and the Contractor shall submit, the name, address, telephone numbers and resumes of additional IH's and industrial hygiene technicians (IHT) who will be assisting the Designated IH in performing onsite tasks. IHs and IHTs supporting the Designated IH shall have a minimum of 2 years of practical onsite asbestos abatement experience. The formal reporting relationship between the Designated IH and the support IHs and IHTs, the Designated Competent Person, and the Contractor shall be indicated.

- d. Asbestos Abatement Workers: Asbestos abatement workers shall meet the requirements contained in 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and other applicable federal, state and local requirements. Worker training documentation shall be provided as required on the "Certificate of Workers Acknowledgment" in this paragraph.
- e. Worker Training and Certification of Worker Acknowledgment: Training documentation will be required for each employee who will perform OSHA Class I, Class II, Class III, or Class IV asbestos abatement operations. Such documentation shall be submitted on a Contractor generated form titled "Certificate of Workers Acknowledgment", to be completed for each employee in the same format and containing the same information as the example certificate at the end of this section. Training course completion certificates (initial and most recent update refresher) required by the information checked on the form shall be attached.
- f. Physician: The Contractor shall provide the name, medical qualifications, address, telephone number and resume of the physician who will or has performed the medical examinations and

evaluations of the persons who will conduct the asbestos abatement work tasks. The physician shall be currently licensed by the state where the workers will be or have been examined, have expertise in pneumoconiosis and shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1926, Section .1101 and paragraph MEDICAL REQUIREMENTS. The physician shall be familiar with the site's hazards and the scope of this project.

g. First Aid and CPR Trained Persons: The names of at least 2 persons who are currently trained in first aid and CPR by the American Red Cross or other approved agency shall be designated and shall be onsite at all times during site operations. They shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030 and shall be included in the Contractor's Bloodborne Pathogen Program. These persons may perform other duties but shall be immediately available to render first aid when needed. A copy of each designated person's current valid First Aid and CPR certificate shall be provided.

h. Independent Testing Laboratory: The Contractor shall provide the name, address and telephone number of the independent testing laboratory selected to perform the sample analyses and report the results. The testing laboratory shall be completely independent from the Contractor as recognized by federal, state or local regulations. Written verification of the following criteria, signed by the testing laboratory principal and the Contractor, shall be submitted:

(1) Phase contrast microscopy (PCM): The laboratory is fully equipped and proficient in conducting PCM of airborne samples using the methods specified by 29 CFR 1926, Section .1101, OSHA method ID-160, the most current version of NIOSH Pub No. 84-100 Method 7400; the laboratory is currently judged proficient (classified as acceptable) in counting airborne asbestos samples by PCM by successful participation in each of the last 4 rounds in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program; the names of the selected microscopists who will analyze airborne samples by PCM with verified documentation of their proficiency to conduct PCM analyses by being judged proficient in counting samples as current participating analysts in the AIHA PAT Program, and having successfully completed the Asbestos Sampling and Analysis course (NIOSH 582 or equivalent) with a copy of course completion certificate provided; when the PCM analysis is to be conducted onsite, documentation shall be provided certifying that the onsite analyst meets the same requirements.

(2) Polarized light microscopy (PLM): The laboratory is fully equipped and proficient in conducting PLM analyses of suspect ACM bulk samples in accordance with 40 CFR 763, Subpart E, Appendix E; the laboratory is currently accredited by NIST under the NVLAP for

bulk asbestos analysis and will use analysts (names shall be provided) with demonstrated proficiency to conduct PLM to include its application to the identification and quantification of asbestos content.

(3) PCM: The laboratory is fully equipped and each analyst (name shall be provided) possesses demonstrated proficiency in conducting PCM analysis of airborne samples using NIOSH Pub No. 84-100Method 7400 PCM.

- i. Disposal Facility, Transporter: The Contractor shall provide written evidence that the landfill to be used is approved for asbestos disposal by the USEPA and state and local regulatory agencies. Copies of signed agreements between the Contractor (including subcontractors and transporters) and the asbestos waste disposal facility to accept and dispose of all asbestos containing waste generated during the performance of this contract shall be provided. Qualifications shall be provided for each subcontractor or transporter to be used, indicating previous experience in transport and disposal of asbestos waste to include all required state and local waste hauler requirements for asbestos. The Contractor and transporters shall meet the DOT requirements of 49 CFR 171, 49 CFR 172, and 49 CFR 173 as well as registration requirements of 49 CFR 107 and other applicable state or local requirements. The disposal facility shall meet the requirements of 40 CFR 61, Sections .154 or .155, as required in 40 CFR 61, Section .150(b), and other applicable state or local requirements.

1.5.3 Federal, State or Local Citations on Previous Projects

The Contractor and all subcontractors shall submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If there are none, a negative declaration signed by an officer of the company shall be provided.

1.6 REGULATORY REQUIREMENTS

In addition to detailed requirements of this specification, work performed under this contract shall comply with EM 385-1-1, applicable federal, state, and local laws, ordinances, criteria, rules and regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. This includes, but is not limited to, OSHA standards, 29 CFR 1926, especially Section .1101, 40 CFR 61, Subpart M and 40 CFR 763. Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply. The following state and local laws, rules and

regulations regarding demolition, removal, encapsulation, construction alteration, repair, maintenance, renovation, spill/emergency cleanup, housekeeping, handling, storing, transporting and disposing of asbestos material apply: HIOSH 12-145 and HAR Chapter 501, HAR Chapter 502, HAR Chapter 503, HAR Chapter 504.

1.7 SAFETY AND HEALTH PROGRAM AND PLANS

The Contractor shall develop and submit a written comprehensive site-specific Accident Prevention Plan at least 30 days prior to the preconstruction conference. The Accident Prevention Plan shall address requirements of EM 385-1-1, Appendix A, covering onsite work to be performed by the Contractor and subcontractors. The Accident Prevention Plan shall incorporate an Asbestos Hazard Abatement Plan, and Activity Hazard Analyses as separate appendices into 1 site specific Accident Prevention Plan document. Any portions of the Contractor's overall Safety and Health Program that are referenced in the Accident Prevention Plan, e.g., respirator program, hazard communication program, confined space entry program, etc., shall be included as appendices to the Accident Prevention Plan. The plan shall take into consideration all the individual asbestos abatement work tasks identified in Table 1. The plan shall be prepared, signed (and sealed, including certification number if required), and dated by the Contractor's Designated IH, Competent Person, and Project Supervisor.

1.7.1 Asbestos Hazard Abatement Plan Appendix

The Asbestos Hazard Abatement Plan appendix to the Accident Prevention Plan shall include, but not be limited to, the following:

- a. The personal protective equipment to be used;
- b. The location and description of regulated areas including clean and dirty areas, access tunnels, and decontamination unit (clean room, shower room, equipment room, storage areas such as load-out unit);
- c. Initial exposure assessment in accordance with 29 CFR 1926, Section .1101;
- d. Level of supervision;
- e. Method of notification of other employers at the worksite;
- f. Abatement method to include containment and control procedures;
- g. Interface of trades involved in the construction;
- h. Sequencing of asbestos related work;
- i. Storage and disposal procedures and plan;
- j. Type of wetting agent and asbestos encapsulant to be used;

- k. Location of local exhaust equipment;
- l. Air monitoring methods (personal, environmental and clearance);
- m. Bulk sampling and analytical methods (if required);
- n. A detailed description of the method to be employed in order to control the spread of ACM wastes and airborne fiber concentrations;
- o. Fire and medical emergency response procedures;
- p. The security procedures to be used for all regulated areas.

1.7.2 Activity Hazard Analyses Appendix

Activity Hazard Analyses, for each major phase of work, shall be submitted and updated during the project. The Activity Hazard Analyses format shall be in accordance with EM 385-1-1 (Figure 1-1). The analysis shall define the activities to be performed for a major phase of work, identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the Activity Hazard Analyses has been accepted and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the onsite Government representatives. The Activity Hazard Analyses shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations.

1.8 PRECONSTRUCTION CONFERENCE AND ONSITE SAFETY

The Contractor and the Contractor's Designated Competent Person, Project Supervisor, and Designated IH shall meet with the Contracting Officer prior to beginning work at a safety preconstruction conference to discuss the details of the Contractor's submitted Accident Prevention Plan to include the Asbestos Hazard Abatement Plan and Activity Hazard Analyses appendices. Deficiencies in the Accident Prevention Plan will be discussed and the Accident Prevention Plan shall be revised to correct the deficiencies and resubmitted for acceptance. Any changes required in the specification as a result of the Accident Prevention Plan shall be identified specifically in the plan to allow for free discussion and acceptance by the Contracting Officer, prior to the start of work. Onsite work shall not begin until the Accident Prevention Plan has been accepted. A copy of the written Accident Prevention Plan shall be maintained onsite. Changes and modifications to the accepted Accident Prevention Plan shall be made with the knowledge and concurrence of the Designated IH, the Project Supervisor, Designated Competent Person, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, the Designated IH shall bring such hazard to the attention of the Project Supervisor, Designated Competent Person, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, all necessary action shall be taken by the Contractor to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Once accepted by the Contracting Officer, the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan

and Activity Hazard Analyses will be enforced as if an addition to the contract. Disregarding the provisions of this contract or the accepted Accident Prevention Plan will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

1.9 SECURITY

The Contractor is responsible for control of anyone entering a existing project site. The area shall be demarcated. A log book shall be kept documenting entry into and out of the regulated area. Entry into regulated areas shall only be by personnel authorized by the Contractor and the Contracting Officer. Personnel authorized to enter regulated areas shall be trained, be medically evaluated, and wear the required personal protective equipment for the specific regulated area to be entered.

1.10 MEDICAL REQUIREMENTS

Medical requirements shall conform to 29 CFR 1926, Section .1101.

1.10.1 Medical Examinations

Before being exposed to airborne asbestos fibers, workers shall be provided with a medical examination as required by 29 CFR 1926, Section .1101 and other pertinent state or local requirements. This requirement shall have been satisfied within the last 12 months. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. X-ray films of asbestos workers shall be identified to the consulting radiologist and medical record jackets shall be marked with the word "asbestos."

1.10.1.1 Information Provided to the Physician

The Contractor shall provide the following information in writing to the examining physician:

- a. A copy of 29 CFR 1926, Section .1101 and Appendices D, E, G, and I;
- b. A description of the affected employee's duties as they relate to the employee's exposure;
- c. The employee's representative exposure level or anticipated exposure level;
- d. A description of any personal protective and respiratory equipment used or to be used;
- e. Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

1.10.1.2 Written Medical Opinion

For each worker, a written medical opinion prepared and signed by a

licensed physician indicating the following:

- a. Summary of the results of the examination.
- b. The potential for an existing physiological condition that would place the employee at an increased risk of health impairment from exposure to asbestos.
- c. The ability of the individual to wear personal protective equipment, including respirators, while performing strenuous work tasks under cold and/or heat stress conditions.
- d. A statement that the employee has been informed of the results of the examination, provided with a copy of the results, informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure, and informed of any medical condition that may result from asbestos exposure.

1.10.2 Medical and Exposure Records

Complete and accurate records shall be maintained of each employee's medical examinations, medical records, and exposure data, as required by 29 CFR 1910, Section .1910.20 and 29 CFR 1926, Section .1101 for a period of 50 years after termination of employment. Records of the required medical examinations and exposure data shall be made available, for inspection and copying, to the Assistant Secretary of Labor for Occupational Safety and Health (OSHA) or authorized representatives of the employee and an employee's physician upon request of the employee or former employee. A copy of the required medical certification for each employee shall be maintained on file at the worksite for review, as requested by the Contracting Officer or the representatives.

1.11 TRAINING PROGRAM

1.11.1 General Training Requirements

The Contractor shall establish a training program as specified by EPA Model Accreditation Plan (MAP), training requirements at 40 CFR 763, Subpart E, Appendix C, the State of HI HAR Chapter 501, HAR Chapter 502, HAR Chapter 503, HAR Chapter 504, OSHA requirements at 29 CFR 1926, Section .1101(k)(9), and this specification. Contractor employees shall complete the required training for the type of work they are to perform and such training shall be documented and provided to the Contracting Officer as specified in paragraph QUALIFICATIONS.

1.11.2 Project Specific Training

Prior to commencement of work, each worker shall be instructed by the Contractor's Designated IH and Competent Person in the following project specific training:

- a. The hazards and health effects of the specific types of ACM to be abated;

- b. The content and requirements of the Contractor's Accident Prevention Plan to include the Asbestos Hazard Abatement Plan and Activity Hazard Analyses and site-specific safety and health precautions;
- c. Hazard Communication Program;
- d. Hands-on training for each asbestos abatement technique to be employed;
- e. Heat and/or cold stress monitoring specific to this project;
- f. Air monitoring program and procedures;
- g. Medical surveillance to include medical and exposure record-keeping procedures;
- h. The association of cigarette smoke and asbestos-related disease;
- i. Security procedures;
- j. Specific work practice controls and engineering controls required for each Class of work in accordance with 29 CFR 1926, Section .1101.

1.12 RESPIRATORY PROTECTION PROGRAM

The Contractor's Designated IH shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926, Section .1101, 29 CFR 1910, Section .134, ANSI Z88.2, CGA G-7, CGA G-7.1 and DETAIL SHEET 12. The Contractor's Designated IH shall establish minimum respiratory protection requirements based on measured or anticipated levels of airborne asbestos fiber concentrations encountered during the performance of the asbestos abatement work. The Contractor's respiratory protection program shall include, but not be limited to, the following elements:

- a. The company policy, used for the assignment of individual responsibility, accountability, and implementation of the respiratory protection program.
- b. The standard operating procedures covering the selection and use of respirators. Respiratory selection shall be determined by the hazard to which the worker is exposed.
- c. Medical evaluation of each user to verify that the worker may be assigned to an activity where respiratory protection is required.
- d. Training in the proper use and limitations of respirators.
- e. Respirator fit-testing, i.e., quantitative, qualitative and individual functional fit checks.
- f. Regular cleaning and disinfection of respirators.
- g. Routine inspection of respirators during cleaning and after each

use when designated for emergency use.

- h. Storage of respirators in convenient, clean, and sanitary locations.
- i. Surveillance of regulated area conditions and degree of employee exposure (e.g., through air monitoring).
- j. Regular evaluation of the continued effectiveness of the respiratory protection program.
- k. Recognition and procedures for the resolution of special problems as they affect respirator use (e.g., no facial hair that comes between the respirator face piece and face or interferes with valve function; prescription eye wear usage; contact lenses usage; etc.).
- l. Proper training in putting on and removing respirators.

1.12.1 Respiratory Fit Testing

A qualitative or quantitative fit test conforming to 29 CFR 1926, Section 1101, Appendix C shall be conducted by the Contractor's Designated IH for each Contractor worker required to wear a respirator, and for the Contracting Officer and authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test shall be performed for each worker wearing a negative-pressure respirator prior to initially wearing a respirator on this project and every 6 months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, or of full-facepiece air purifying respirators where they are worn at levels at which half-facepiece air purifying respirators are permitted. If physical changes develop that will affect the fit, a new fit test for the worker shall be performed. Functional fit checks shall be performed by employees each time a respirator is put on and in accordance with the manufacturer's recommendation.

1.12.2 Respirator Selection and Use Requirements

The Contractor shall provide respirators, and ensure that they are used as required by 29 CFR 1926, Section .1101 and in accordance with the manufacturer's recommendations. Respirators shall be jointly approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (MSHA/NIOSH), or by NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. Personnel who handle ACM, enter regulated areas that require the wearing of a respirator, or who are otherwise carrying out abatement activities that require the wearing of a respirator, shall be provided with approved respirators that are fully protective of the worker at the measured or anticipated airborne asbestos concentration level to be encountered. For air-purifying respirators, the particulate filter portion of the cartridges or canister approved for use in airborne asbestos environments shall be high-efficiency particulate air (HEPA). The initial respirator selection and the decisions regarding the upgrading or

downgrading of respirator type shall be made by the Contractor's Designated IH based on the measured or anticipated airborne asbestos fiber concentrations to be encountered. Recommendations made by the Contractor's Designated IH to downgrade respirator type shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person in consultation with the Designated IH, shall have the authority to take immediate action to upgrade or downgrade respiratory type when there is an immediate danger to the health and safety of the wearer. Respirators shall be used in the following circumstances:

- a. During all Class I asbestos jobs.
- b. During all Class II work where the ACM is not removed in a substantially intact state.
- c. During all Class II and III work which is not performed using wet methods. Respirators need not be worn during removal of ACM from sloped roofs when a negative exposure assessment has been made and ACM is removed in an intact state.
- d. During all Class II and III asbestos jobs where the Contractor does not produce a negative exposure assessment.
- e. During all Class III jobs where TSI or surfacing ACM is being disturbed.
- f. During all Class IV work performed within regulated areas where employees performing other work are required to wear respirators.
- g. During all work where employees are exposed above the PEL-TWA or PEL-Excursion Limit.
- h. In emergencies

1.12.3 Class I Work

The Contractor shall provide: (1) a tight-fitting, powered air purifying respirator equipped with high efficiency filters, or (2) a full-facepiece supplied air respirator operated in the pressure demand mode, equipped with HEPA egress cartridges, or (3) an auxiliary positive pressure self-contained breathing apparatus, for all employees within the regulated area where Class I work is being performed; provided that a negative exposure assessment has not been produced, and that the exposure level will not exceed 1 f/cc as an 8-hour time weighted average. A full-facepiece supplied air respirator, operated in the pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus shall be provided under such conditions, if the exposure assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.

1.12.4 Class II and III Work

The Contractor shall provide an air purifying respirator, other than a disposable respirator, equipped with high-efficiency filters whenever the employee performs Class II and III asbestos jobs where the Contractor does

not produce a negative exposure assessment ; and Class III jobs where TSI or surfacing ACM is being disturbed.

1.12.5 Sanitation

Employees who wear respirators shall be permitted to leave work areas to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.

1.13 HAZARD COMMUNICATION PROGRAM

A hazard communication program shall be established and implemented in accordance with 29 CFR 1926, Section .59. Material safety data sheets (MSDSs) shall be provided for all hazardous materials brought onto the worksite. One copy shall be provided to the Contracting Officer and 1 copy shall be included in the Contractor's Hazard Communication Program.

1.14 LICENSES, PERMITS AND NOTIFICATIONS

1.14.1 General Legal Requirements

Necessary licenses, permits and notifications shall be obtained in conjunction with the project's asbestos abatement, transportation and disposal actions and timely notification furnished of such actions as required by federal, state, regional, and local authorities. The Contractor shall notify the Regional Office of the USEPA, state's environmental protection agency responsible for asbestos air emissions and the Contracting Officer in writing, at least 10 days prior to the commencement of work, in accordance with 40 CFR 61, Subpart M, and state and local requirements to include the mandatory "Notification of Demolition and Renovation Record" form and other required notification documents. Notification shall be by Certified Mail, Return Receipt Requested. The Contractor shall furnish copies of the receipts to the Contracting Officer, in writing, prior to the commencement of work. A copy of the rental company's written acknowledgment and agreement shall be provided as required by paragraph RENTAL EQUIPMENT. For licenses, permits, and notifications that the Contractor is responsible for obtaining, the Contractor shall pay any associated fees or other costs incurred.

1.14.2 Litigation and Notification

The Contractor shall notify the Contracting Officer if any of the following occur:

- a. The Contractor or any of the subcontractors are served with notice of violation of any law, regulation, permit or license which relates to this contract;
- b. Proceedings are commenced which could lead to revocation of related permits or licenses; permits, licenses or other Government authorizations relating to this contract are revoked;
- c. Litigation is commenced which would affect this contract;

- d. The Contractor or any of the subcontractors become aware that their equipment or facilities are not in compliance or may fail to comply in the future with applicable laws or regulations.

1.15 PERSONAL PROTECTIVE EQUIPMENT

Three complete sets of personal protective equipment shall be made available to the Contracting Officer and authorized visitors for entry to the regulated area. Contracting Officer and authorized visitors shall be provided with training equivalent to that provided to Contractor employees in the selection, fitting, and use of the required personal protective equipment and the site safety and health requirements. Contractor workers shall be provided with personal protective clothing and equipment and the Contractor shall ensure that it is worn properly. The Contractor's Designated IH and Designated Competent Person shall select and approve all the required personal protective clothing and equipment to be used.

1.15.1 Respirators

Respirators shall be in accordance with paragraph RESPIRATORY PROTECTION PROGRAM.

1.15.2 Whole Body Protection

Personnel exposed to airborne concentrations of asbestos that exceed the PELs, or for all OSHA Classes of work for which a required negative exposure assessment is not produced, shall be provided with whole body protection and such protection shall be worn properly. The Contractor's Designated IH and Competent Person shall select and approve the whole body protection to be used. The Competent Person shall examine work suits worn by employees at least once per work shift for rips or tears that may occur during performance of work. When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the work suit shall be immediately replaced. Disposable whole body protection shall be disposed of as asbestos contaminated waste upon exiting from the regulated area. Reusable whole body protection worn shall be either disposed of as asbestos contaminated waste upon exiting from the regulated area or be properly laundered in accordance with 29 CFR 1926, Section .1101.

Whole body protection used for asbestos abatement shall not be removed from the worksite by a worker to be cleaned. Recommendations made by the Contractor's Designated IH to downgrade whole body protection shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person, in consultation with the Designated IH, has the authority to take immediate action to upgrade or downgrade whole body protection when there is an immediate danger to the health and safety of the wearer.

1.15.2.1 Coveralls

Disposable-breathable coveralls with a zipper front shall be provided. Sleeves shall be secured at the wrists, and foot coverings secured at the ankles. See DETAIL SHEET 13.

1.15.2.2 Gloves

Gloves shall be provided to protect the hands. Where there is the potential for hand injuries (i.e., scrapes, punctures, cuts, etc.) a suitable glove shall be provided and used.

1.15.2.3 Foot Coverings

Cloth socks shall be provided and worn next to the skin. Footwear, as required by OSHA and EM 385-1-1, that is appropriate for safety and health hazards in the area shall be worn. Rubber boots shall be used in moist or wet areas. Reusable footwear removed from the regulated area shall be thoroughly decontaminated or disposed of as ACM waste. Disposable protective foot covering shall be disposed of as ACM waste. If rubber boots are not used, disposable foot covering shall be provided.

1.15.2.4 Head Covering

Hood type disposable head covering shall be provided. In addition, protective head gear (hard hats) shall be provided as required. Hard hats shall only be removed from the regulated area after being thoroughly decontaminated.

1.15.2.5 Protective Eye Wear

Eye protection provided shall be in accordance with ANSI Z87.1.

1.16 HYGIENE FACILITIES AND PRACTICES

The Contractor shall establish a decontamination area for the decontamination of employees, material and equipment. The Contractor shall ensure that employees enter and exit the regulated area through the decontamination area.

1.16.1 Shower Facilities

Shower facilities, when provided, shall comply with 29 CFR 1910, Section .141(d)(3).

1.16.2 3-Stage Decontamination Area

A temporary negative pressure decontamination unit that is adjacent and attached in a leak-tight manner to the regulated area shall be provided as described in SET-UP DETAIL SHEET Numbers 22. The decontamination unit shall have an equipment room and a clean room separated by a shower that complies with 29 CFR 1910, Section .141 (unless the Contractor can demonstrate that such facilities are not feasible). Equipment and surfaces of containers filled with ACM shall be cleaned prior to removing them from the equipment room or area. Surfaces of the equipment room shall be wet wiped 2 times after each shift. Materials used for wet wiping shall be disposed of as asbestos contaminated waste. Two separate lockers shall be provided for each asbestos worker, one in the equipment room and one in the clean room. The Contractor shall provide a minimum of 2 showers. The wastewater pump shall be sized for 1.25 times the showerhead flow-rate at a pressure head sufficient to satisfy the filter head loss and discharge line losses. The pump shall supply a minimum 1.6 L/s flow with 10.7 m of

pressure head. Used shower water shall be collected and filtered to remove asbestos contamination. Filters and residue shall be disposed of as asbestos contaminated material, per DETAIL SHEETS 9 and 14. Filtered water shall be discharged to the sanitary system. Wastewater filters shall be installed in series with the first stage pore size of 20 microns and the second stage pore size of 5 microns. The floor of the decontamination unit's clean room shall be kept dry and clean at all times. Water from the shower shall not be allowed to wet the floor in the clean room. Surfaces of the clean room and shower shall be wet-wiped 2 times after each shift change with a disinfectant solution. Proper housekeeping and hygiene requirements shall be maintained. Soap and towels shall be provided for showering, washing and drying. Any cloth towels provided shall be disposed of as ACM waste or shall be laundered in accordance with 29 CFR 1926, Section .1101.

1.16.3 Decontamination Area Entry Procedures

The Contractor shall ensure that employees entering the decontamination area through the clean room or clean area:

- a. Remove street clothing in the clean room or clean area and deposit it in lockers.
- b. Put on protective clothing and respiratory protection before leaving the clean room or clean area.
- c. Pass through the equipment room to enter the regulated area.

1.16.4 Decontamination Area Exit Procedures

The Contractor shall ensure that the following procedures are followed:

- a. Before leaving the regulated area, respirators shall be worn while employees remove all gross contamination and debris from their work clothing using a HEPA vacuum.
- b. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers (see Detail Sheets 9 and 14) for disposal and/or laundering.
- c. Employees shall not remove their respirators in the equipment room.
- d. Employees shall shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, the Contractor shall ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

- e. After showering, employees shall enter the clean room before changing into street clothes.

1.16.5 Lunch Areas

The Contractor shall provide lunch areas in which the airborne concentrations of asbestos are below 0.01 f/cc.

1.16.6 Smoking

Smoking, if allowed by the Contractor, shall only be permitted in designated areas approved by the Contracting Officer.

1.17 REGULATED AREAS

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they shall demarcate the regulated area. Access to regulated areas shall be limited to authorized persons. The Contractor shall control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

1.18 WARNING SIGNS AND TAPE

Warning signs and tape printed in English shall be provided at the regulated boundaries and entrances to regulated areas. The Contractor shall ensure that all personnel working in areas contiguous to regulated areas comprehend the warning signs. Signs shall be located to allow personnel to read the signs and take the necessary protective steps required before entering the area. Warning signs, as shown and described in DETAIL SHEET 11, shall be in vertical format conforming to 29 CFR 1910 and 29 CFR 1926, Section .1101, a minimum of 500 by 350 mm , and displaying the following legend in the lower panel:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

Spacing between lines shall be at least equal to the height of the upper of any two lines. Warning tape shall be provided as shown and described on DETAIL SHEET 11. Decontamination unit signage shall be as shown and described on DETAIL SHEET 15.

1.19 WARNING LABELS

Warning labels shall be affixed to all asbestos disposal containers used to contain asbestos materials, scrap, waste debris, and other products contaminated with asbestos. Containers with preprinted warning labels

conforming to requirements are acceptable. Warning labels shall be as described in DETAIL SHEET 14, shall conform to 29 CFR 1926, Section .1101 and shall be of sufficient size to be clearly legible displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

1.20 LOCAL EXHAUST VENTILATION

Local exhaust ventilation units shall conform to ANSI Z9.2 and 29 CFR 1926, Section .1101. Filters on local exhaust system equipment shall conform to ANSI Z9.2 and UL 586. Filter shall be UL labeled.

1.21 TOOLS

Vacuums shall be leak proof to the filter, equipped with HEPA filters, of sufficient capacity and necessary capture velocity at the nozzle or nozzle attachment to efficiently collect, transport and retain the ACM waste material. Power tools shall not be used to remove ACM unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation capture and collection system, or has otherwise been approved for use by the Contracting Officer. Residual asbestos shall be removed from reusable tools prior to storage and reuse. Reusable tools shall be thoroughly decontaminated prior to being removed from regulated areas.

1.22 RENTAL EQUIPMENT

If rental equipment is to be used, written notification shall be provided to the rental agency, concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment and the steps that will be taken to decontaminate such equipment. A written acceptance of the terms of the Contractor's notification shall be obtained from the rental agency.

1.23 AIR MONITORING EQUIPMENT

The Contractor's Designated IH shall approve air monitoring equipment to be used to collect samples. The equipment shall include, but shall not be limited to:

- a. High-volume sampling pumps that can be calibrated and operated at a constant airflow up to 16 liters per minute when equipped with a sampling train of tubing and filter cassette.
- b. Low-volume, battery powered, body-attachable, portable personal pumps that can be calibrated to a constant airflow up to approximately 3.5 liters per minute when equipped with a sampling train of tubing and filter cassette, and a self-contained rechargeable power pack capable of sustaining the calibrated flow rate for a minimum of 10 hours. The pumps shall also be equipped with an automatic flow control unit which shall maintain a

constant flow, even as filter resistance increases due to accumulation of fiber and debris on the filter surface.

- c. Single use standard 25 mm diameter cassette, open face, 0.8 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive extension cowl, and shrink bands, to be used with low flow pumps in accordance with 29 CFR 1926, Section .1101 for personal air sampling.
- d. Single use standard 25 mm diameter cassette, open face, 0.45 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive cowl, and shrink bands, to be used with high flow pumps when conducting environmental area sampling using NIOSH Pub No. 84-100 Methods 7400.
- e. Appropriate plastic tubing to connect the air sampling pump to the selected filter cassette.
- f. A flow calibrator capable of calibration to within plus or minus 2 percent of reading over a temperature range of minus 20 to plus 60 degrees C and traceable to a NIST primary standard.

1.24 EXPENDABLE SUPPLIES

1.24.1 Glovebag

Glovebags shall be provided as described in 29 CFR 1926, Section .1101 and SET-UP DETAIL SHEET 10. The glovebag assembly shall be 0.15 mm thick plastic, prefabricated and seamless at the bottom with preprinted OSHA warning label.

1.24.2 Duct Tape

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container shall be provided.

1.24.3 Disposal Containers

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill out) disposal containers shall be provided for ACM wastes as required by 29 CFR 1926 Section .1101 and DETAIL SHEETS 9A, 9B, 9C and 14.

1.24.4 Disposal Bags

Leak-tight bags, 0.15 mm thick, shall be provided for placement of asbestos generated waste as described in DETAIL SHEET 9A.

1.24.5 Sheet Plastic

Sheet plastic shall be polyethylene of 0.15 mm minimum thickness and shall be provided in the largest sheet size necessary to minimize seams, as indicated on the project drawings. Film shall be clear and conform to ASTM D 4397, except as specified below:

1.24.6 Amended Water

Amended water shall meet the requirements of ASTM D 1331.

1.24.7 Mastic Removing Solvent

Mastic removing solvent shall be nonflammable and shall not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite shall have a flash point greater than 60 degrees C.

1.24.8 Leak-tight Wrapping

Two layers of 0.15 mm minimum thick polyethylene sheet stock shall be used for the containment of removed asbestos-containing components or materials such as reactor vessels, large tanks, boilers, insulated pipe segments and other materials too large to be placed in disposal bags as described in DETAIL SHEET 9B. Upon placement of the ACM component or material, each layer shall be individually leak-tight sealed with duct tape.

1.24.9 Wetting Agents

Removal encapsulant (a penetrating encapsulant) shall be provided when conducting removal abatement activities that require a longer removal time or are subject to rapid evaporation of amended water. The removal encapsulant shall be capable of wetting the ACM and retarding fiber release during disturbance of the ACM greater than or equal to that provided by amended water. Performance requirements for penetrating encapsulants are specified in paragraph ENCAPSULANTS.

1.24.10 Strippable Coating

Strippable coating in aerosol cans shall be used to adhere to surfaces and to be removed cleanly by stripping, at the completion of work. This work shall only be done in well ventilated areas.

1.25 MISCELLANEOUS ITEMS

A sufficient quantity of other items, such as, but not limited to: scrapers, brushes, brooms, staple guns, tarpaulins, shovels, rubber squeegees, dust pans, other tools, scaffolding, staging, enclosed chutes, wooden ladders, lumber necessary for the construction of containments, UL approved temporary electrical equipment, material and cords, ground fault circuit interrupters, water hoses of sufficient length, fire extinguishers, first aid kits, portable toilets, logbooks, log forms, markers with indelible ink, spray paint in bright color to mark areas, project boundary fencing, etc., shall be provided.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Encapsulants shall conform to USEPA requirements, shall contain no toxic or hazardous substances and no solvent and shall meet the following

requirements:

Additional Requirements for Lockdown Encapsulant

Requirement	Test Standard
Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength, 1.5 kN/m (Tests compatibility with cementitious and fibrous fireproofing)	ASTM E 736

2.2 RECYCLABLE MATERIALS

The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Asbestos abatement work tasks shall be performed as shown on the detailed plans and drawings, as summarized in paragraph DESCRIPTION OF WORK and including Table 1 and the Contractor's Accident Prevention Plan, Asbestos Hazard Abatement Plan, and the Activity Hazard Analyses. The Contractor shall use the engineering controls and work practices required in 29 CFR 1926, Section .1101(g) in all operations regardless of the levels of exposure. Personnel shall wear and utilize protective clothing and equipment as specified. The Contractor shall not permit eating, smoking, drinking, chewing or applying cosmetics in the regulated area. All hot work (burning, cutting, welding, etc.) shall be conducted under controlled conditions in conformance with 29 CFR 1926, Section .352, Fire Prevention. Personnel of other trades, not engaged in asbestos abatement activities, shall not be exposed at any time to airborne concentrations of asbestos unless all the administrative and personal protective provisions of the Contractor's Accident Prevention Plan are complied with. Power to the regulated area shall be locked-out and tagged in accordance with 29 CFR 1910, and temporary electrical service with ground fault circuit interrupters shall be provided as needed. Temporary electrical service shall be disconnected when necessary for wet removal. The Contractor shall stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. The Contractor shall correct the condition to the satisfaction of the Contracting Officer, including visual inspection and air sampling. Work shall resume only upon notification by the Contracting Officer. Corrective actions shall be documented.

3.2 PROTECTION OF ADJACENT WORK OR AREAS TO REMAIN

Asbestos abatement shall be performed without damage to or contamination of adjacent work or area. Where such work or area is damaged or contaminated, as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government, as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, work shall stop in all effected areas immediately and the spill shall be cleaned. When satisfactory visual inspection and air sampling analysis results are obtained and have been evaluated by the Contractor's Designated IH and the Contracting Officer, work shall proceed.

3.3 OBJECTS

3.3.1 Removal of Mobile Objects

Mobile objects, furniture and equipment will be removed from the area of work by the Government before asbestos abatement work begins.

3.4 METHODS OF COMPLIANCE

3.4.1 Mandated Practices

The Contractor shall employ proper handling procedures in accordance with 29 CFR 1926 and 40 CFR 61, Subpart M, and the specified requirements. The specific abatement techniques and items identified shall be detailed in the Contractor's Asbestos Hazard Abatement Plan including, but not limited to, details of construction materials, equipment, and handling procedures. The Contractor shall use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

- a. Vacuum cleaners equipped with HEPA filters to collect debris and dust containing ACM.
- b. Wet methods or wetting agents to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup; except where it can be demonstrated that the use of wet methods is unfeasible due to, for example, the creation of electrical hazards, equipment malfunction, and in roofing.
- c. Prompt clean-up and disposal in leak-tight containers of wastes and debris contaminated with asbestos.
- d. Inspection and repair of polyethylene in work and high traffic areas.
- e. Cleaning of equipment and surfaces of containers filled with ACM prior to removing them from the equipment room or area.

3.4.2 Control Methods

The Contractor shall use the following control methods to comply with the

PELs:

- a. Local exhaust ventilation equipped with HEPA filter dust collection systems;
- b. Enclosure or isolation of processes producing asbestos dust;
- c. Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;
- d. Use of other work practices and engineering controls;
- e. Where the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the PELs, the Contractor shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory protection that complies with paragraph, RESPIRATORY PROTECTION PROGRAM.

3.4.3 Unacceptable Practices

The following work practices and engineering controls shall not be used for work related to asbestos or for work which disturbs ACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:

- a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.
- b. Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.
- c. Dry sweeping, shoveling, or other dry clean-up of dust and debris containing ACM.
- d. Employee rotation as a means of reducing employee exposure to asbestos.

3.4.4 Class I Work Procedures

In addition to requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

- a. A Competent Person shall supervise the installation and operation of the control system.
- b. For jobs involving the removal of more than 7.5 m² or 0.9 square meters of TSI or surfacing material, the Contractor shall place critical barriers over all openings to the regulated area.

- c. HVAC systems shall be isolated in the regulated area by sealing with a double layer of plastic or air-tight rigid covers.
- d. Impermeable dropcloths (0.15 mm or greater thickness) shall be placed on surfaces beneath all removal activity.
- e. Objects within the regulated area shall be handled as specified in paragraph OBJECTS.
- f. Where a negative exposure assessment has not been provided or where exposure monitoring shows the PEL was exceeded, the regulated area shall be ventilated to move contaminated air away from the employee's breathing zone toward a HEPA unit or collection device.

3.4.5 Specific Control Methods for Class I Work

In addition to requirements of paragraph Class I Work Procedures, Class I asbestos work shall be performed using the control methods identified in the subparagraphs below.

3.4.5.1 Negative Pressure Enclosure (NPE) System

The NPE system shall be as shown in SETUP DETAIL SHEET 4. The system shall provide at least 4 air changes per hour inside the containment. The local exhaust unit equipment shall be operated 24 hours per day until the containment is removed, and shall be leak-proof to the filter and equipped with HEPA filters. Air movement shall be directed away from the employees and toward a HEPA filtration device. The NPE shall be smoke tested for leaks at the beginning of each shift. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.5 mm of water column relative to adjacent, unsealed areas. Pressure differential shall be monitored continuously, 24 hours per day, with an automatic manometric recording instrument. Pressure differential recordings shall be provided daily on the same day collected. Readings shall be reviewed by the Contractor's Designated Competent Person and IH prior to submittal. The Contracting Officer shall be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system shall not be used as the local exhaust system for the regulated area. The local exhaust system shall terminate outdoors unless an alternate arrangement is allowed by the Contract Officer. All filters used shall be new at the beginning of the project and shall be periodically changed as necessary and disposed of as ACM waste.

3.4.5.2 Glovebag Systems

Glovebag systems shall be as shown in SETUP DETAIL SHEET 10. The glovebag system shall be used to remove ACM from straight runs of piping and elbows and other connections. Glovebags shall be used without modification and shall be smoke-tested for leaks and any leaks sealed prior to use. Glovebags shall be installed to completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be moved. Glovebags shall not be used on surfaces

that have temperatures exceeding 66 degrees C. Prior to disposal, glovebags shall be collapsed by removing air within them using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform Class I glovebag removal. Asbestos regulated work areas shall be established as specified and shown on detailed drawings and plans for glovebag abatement. Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape as specified in SET-UP DETAIL SHEET 11.

- a. In addition to requirements for negative pressure glovebag systems above, the Contractor shall attach HEPA vacuum systems or other devices to the bag to prevent collapse during removal of ACM from straight runs of piping and elbows and other connections.
- b. The negative pressure glove boxes used to remove ACM from pipe runs shall be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure shall be created in the system using a HEPA filtration system. The box shall be smoke tested for leaks prior to each use.

3.4.5.3 Wrap and Cut Operation

Wrap and cut operations shall be as shown in SETUP DETAIL SHEET 9B, 10. Prior to cutting pipe, or ventilation ducts with asbestos flex connectors, the asbestos-containing insulation or duct shall be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps shall be taken: install glovebag, strip back sections to be cut 150 mm from point of cut, and cut pipe into manageable sections.

3.4.6 Class II Work

In addition to the requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

- a. A Competent Person shall supervise the work.
- b. For indoor work, critical barriers shall be placed over all openings to the regulated area.
- c. Impermeable dropcloths shall be placed on surfaces beneath all removal activity.

3.4.7 Specific Control Methods for Class II Work

In addition to requirements of paragraph Class II Work, Class II work shall be performed using the following methods:

3.4.7.1 Vinyl and Asphalt Flooring Materials

When removing vinyl and asphalt flooring materials which contain ACM, the Contractor shall use the following practices as shown in RESPONSE ACTION DETAIL SHEET 57. Resilient sheeting shall be removed by adequately wet methods. Tiles shall be removed intact (if possible); wetting is not required when tiles are heated and removed intact. Flooring or its backing shall not be sanded. Scraping of residual adhesive and/or backing shall be performed using wet methods. Mechanical chipping is prohibited unless performed in a negative pressure enclosure. Dry sweeping is prohibited. The Contractor shall use vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) to clean floors.

3.4.7.2 Roofing Material

When removing roofing materials which contain ACM as described in 29 CFR 1926, Section .1101(g)(8)(ii), the Contractor shall use the following practices as shown in RESPONSE ACTION DETAIL SHEET 74. Roofing material shall be removed in an intact state. Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards. When removing built-up roofs, with asbestos-containing roofing felts and an aggregate surface, using a power roof cutter, all dust resulting from the cutting operations shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. Asbestos-containing roofing material shall not be dropped or thrown to the ground, but shall be lowered to the ground via covered, dust-tight chute, crane, hoist or other method approved by the Contracting Officer. Any ACM that is not intact shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. While the material remains on the roof it shall be kept wet or placed in an impermeable waste bag or wrapped in plastic sheeting. Intact ACM shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. Unwrapped material shall be transferred to a closed receptacle precluding the dispersion of dust. Critical barriers shall be placed over roof level heating and ventilation air intakes.

3.4.7.3 Cementitious Siding and Shingles or Transite Panels

When removing cementitious asbestos-containing transite panels the Contractor shall use the following practices shown in RESPONSE ACTION DETAIL SHEET 81. Intentionally cutting, abrading or breaking transite panels is prohibited. Each panel shall be sprayed with amended water prior to removal. Nails shall be cut with flat, sharp instruments. Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

3.4.7.4 HVAC Flex Connector

HVAC Flex Connector shall be thoroughly wetted with amended water prior to removal and immediately placed in a disposal container. If a HVAC Flex Connector gasket is visibly deteriorated and unlikely to be removed intact,

removal shall be undertaken within a glovebag. Any scraping to remove residue shall be performed wet.

3.4.7.5 Other Class II Jobs

The Contractor shall use the following work practices when performing Class II removal of pipe sealant and ACM: The material shall be thoroughly wetted with amended water prior and during its removal. The material shall be removed in an intact state. Cutting, abrading or breaking the material is prohibited. The ACM removed shall be immediately bagged or wrapped.

3.4.8 Alternative Methods for Roofing Materials and Asphaltic Wrap

The Contractor shall use the following engineering controls and work practices when removing, roof cements, mastics, coatings, or flashings which contain asbestos fibers encapsulated or coated by bituminous or resinous compounds. If during the course of the job the material does not remain intact, the Contractor shall use the procedures described in paragraph Roofing Material. Before work begins, and as needed during the job, the Designated Competent Person shall conduct an inspection and determine that the roofing material is intact and will likely remain intact. The material shall not be sanded, abraded, or ground. Manual methods which would render the material non-intact shall not be used. Roofing material shall not be dropped or thrown to the ground but shall be lowered via covered, dust-tight chute, crane, hoist or other method approved by the Contracting Officer. All such material shall be removed from the roof as soon as practicable, but not later than the end of the work shift. Removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

3.4.9 Cleaning After Asbestos Removal

After completion of all asbestos removal work, surfaces from which ACM has been removed shall be wet wiped or sponged clean, or cleaned by some equivalent method to remove all visible residue. Run-off water shall be collected and filtered through a dual filtration system. A first filter shall be provided to remove fibers 20 micrometers and larger, and a final filter provided that removes fibers 5 micrometers and larger. After the gross amounts of asbestos have been removed from every surface, remaining visible accumulations of asbestos on floors shall be collected using plastic shovels, rubber squeegees, rubber dustpans, and HEPA vacuum cleaners as appropriate to maintain the integrity of the regulated area. When TSI and surfacing material has been removed, workmen shall use HEPA vacuum cleaners to vacuum every surface. Surfaces or locations which could harbor accumulations or residual asbestos dust shall be checked after vacuuming to verify that no asbestos-containing material remains; and shall be re-vacuumed as necessary to remove the ACM.

3.4.10 Class I Asbestos Work Response Action Detail Sheets

The following Class I Asbestos Work Response Action Detail Sheet is specified on Table 1 for each individual work task to be performed:

- a. Pipe and Fitting Insulation (using Glovebag): See Sheet 87

- b. Removal of asbestos Flex Connector: See sheet 104 sheet 102
- c. Removal of asbestos cement pipe

3.4.11 Class II Asbestos Work Response Action Detail Sheets

The following Class II Asbestos Work Response Action Detail Sheet is specified on Table 1 for each individual work task to be performed:

- a. Vinyl Asbestos Tile Adhered to Concrete Floor System by Asbestos Containing Adhesive: See Sheet 57
- b. Built-Up Roofing and Flashing: See Sheet 74

3.4.12 Sealing Contaminated Items Designated for Disposal

Contaminated architectural, mechanical, and electrical appurtenances such as Venetian blinds, full height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit panels, and other contaminated items designated for removal shall be coated with an asbestos lockdown encapsulant at the demolition site before being removed from the asbestos control area. These items shall be vacuumed prior to application of the lockdown encapsulant. The asbestos lockdown encapsulant shall be tinted a contrasting color and shall be spray applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces.

3.5 FINAL CLEANING AND VISUAL INSPECTION

Upon completion of abatement, the regulated area shall be cleaned by collecting, packing, and storing all gross contamination; see SET-UP DETAIL SHEETS 9, 14 and 20. A final cleaning shall be performed using HEPA vacuum and wet cleaning of all exposed surfaces and objects in the regulated area. Upon completion of the cleaning, the Contractor shall conduct a visual pre-inspection of the cleaned area in preparation for a final inspection before final air clearance monitoring and recleaning, as necessary. Upon completion of the final cleaning, the Contractor and the Contracting Officer shall conduct a final visual inspection of the cleaned regulated area in accordance with ASTM E 1368 and document the results on the Final Cleaning and Visual Inspection as specified on the SET-UP DETAIL SHEET 19. If the Contracting Officer rejects the clean regulated area as not meeting final cleaning requirements, the Contractor shall reclean as necessary and have a follow-on inspection conducted with the Contracting Officer. Recleaning and follow-up reinspection shall be at the Contractor's expense.

3.6 LOCKDOWN

Prior to removal of plastic barriers and after clean-up of gross contamination and final visual inspection, a post removal (lockdown) encapsulant shall be spray applied to ceiling, walls, floors, and other surfaces in the regulated area.

3.7 EXPOSURE ASSESSMENT AND AIR MONITORING

3.7.1 General Requirements For Exposure

Exposure assessment, air monitoring and analysis of airborne concentration of asbestos fibers shall be performed in accordance with 29 CFR 1926, Section .1101, the Contractor's air monitoring plan, and as specified. Personal exposure air monitoring (collected at the breathing zone) that is representative of the exposure of each employee who is assigned to work within a regulated area shall be performed by the Contractor's Designated IH.

Breathing zone samples shall be taken for at least 25 percent of the workers in each shift, or a minimum of 2, whichever is greater. Air monitoring results at the 95 percent confidence level shall be calculated as shown in Table 2 at the end of this section. The Contractor shall provide an onsite independent testing laboratory with qualified analysts and appropriate equipment to conduct sample analyses of air samples using the methods prescribed in 29 CFR 1926, Section .1101, to include NIOSH Pub No. 84-100 Method 7400. Preabatement and abatement environmental air monitoring shall be performed by the Contractor's Designated IH. Final clearance environmental air monitoring, shall be performed by the Contractor's Designated IH. Environmental and final clearance air monitoring shall be performed using NIOSH Pub No. 84-100 Method 7400 (PCM).

For environmental and final clearance, air monitoring shall be conducted at a sufficient velocity and duration to establish the limit of detection of the method used at 0.005 f/cc. Confirmation of asbestos fiber concentrations (asbestos f/cc) from environmental and final clearance samples collected and analyzed by NIOSH Pub No. 84-100 Method 7400 (total f/cc) may be conducted using TEM in accordance with NIOSH Pub No. 84-100 Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH Pub No. 84-100 Method 7400 PCM analysis. For all Contractor required environmental or final clearance air monitoring, confirmation of asbestos fiber concentrations, using NIOSH Pub No. 84-100 Method 7402, shall be at the Contractor's expense. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. Results of breathing zone samples shall be posted at the job site and made available to the Contracting Officer. The Contractor shall maintain a fiber concentration inside a regulated area less than or equal to 0.1 f/cc expressed as an 8 hour, time-weighted average (TWA) during the conduct of the asbestos abatement. If fiber concentration rises above 0.1 f/cc, work procedures shall be investigated with the Contracting Officer to determine the cause. At the discretion of the Contracting Officer, fiber concentration may exceed 0.1 f/cc but shall not exceed 1.0 f/cc expressed as an 8-hour TWA. The Contractor's workers shall not be exposed to an airborne fiber concentration in excess of 1.0 f/cc, as averaged over a sampling period of 30 minutes. Should either an environmental concentration of 1.0 f/cc expressed as an 8-hour TWA or a personal excursion concentration of 1.0 f/cc expressed as a 30-minute sample occur inside a regulated work area, the Contractor shall stop work immediately, notify the Contracting Officer, and implement additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Work shall not restart until authorized by the Contracting Officer.

3.7.2 Initial Exposure Assessment

The Contractor's Designated IH shall conduct an exposure assessment immediately before or at the initiation of an asbestos abatement operation to ascertain expected exposures during that operation. The assessment shall be completed in time to comply with the requirements which are triggered by exposure data or the lack of a negative exposure assessment, and to provide information necessary to assure that all control systems planned are appropriate for that operation. The assessment shall take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the Contractor which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of PELs, or otherwise makes a negative exposure assessment, the Contractor shall presume that employees are exposed in excess of the PEL-TWA and PEL-Excursion Limit.

3.7.3 Negative Exposure Assessment

The Contractor shall provide a negative exposure assessment for the specific asbestos job which will be performed. The negative exposure assessment shall be provided within 3 days of the initiation of the project and conform to the following criteria:

- a. Objective Data: Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the PEL-TWA and PEL-Excursion Limit under those work conditions having the greatest potential for releasing asbestos.
- b. Prior Asbestos Jobs: Where the Contractor has monitored prior asbestos jobs for the PEL and the PEL-Excursion Limit within 12 months of the current job, the monitoring and analysis were performed in compliance with asbestos standard in effect; the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the Contractor's current operations; the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job; and these data show that under the conditions prevailing and which will prevail in the current workplace, there is a high degree of certainty that the monitoring covered exposure from employee exposures will not exceed the PEL-TWA and PEL-Excursion Limit.
- c. Initial Exposure Monitoring: The results of initial exposure monitoring of the current job, made from breathing zone air samples that are representative of the 8-hour PEL-TWA and 30-minute short-term exposures of each employee. The monitoring covered exposure from operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

3.7.4 Preabatement Environmental Air Monitoring

Preabatement environmental air monitoring shall be established 1 day prior to the masking and sealing operations for each regulated area to determine background concentrations before abatement work begins. As a minimum, preabatement air samples shall be collected using NIOSH Pub No. 84-100 Method 7400, PCM at these locations: outside the building; inside the building, but outside the regulated area perimeter; and inside each regulated work area. One sample shall be collected for every 185 square meters of floor space. At least 2 samples shall be collected outside the building: at the exhaust of the HEPA unit; and downwind from the abatement site. The PCM samples shall be analyzed within 24 hours.

3.7.5 Environmental Air Monitoring During Abatement

Until an exposure assessment is provided to the Contracting Officer, environmental air monitoring shall be conducted at locations and frequencies that will accurately characterize any evolving airborne asbestos fiber concentrations. The assessment shall demonstrate that the product or material containing asbestos minerals, or the abatement involving such product or material, cannot release airborne asbestos fibers in concentrations exceeding 0.01 f/cc as a TWA under those work conditions having the greatest potential for releasing asbestos. The monitoring shall be at least once per shift at locations including, but not limited to, close to the work inside a regulated area; preabatement sampling locations; outside entrances to a regulated area; close to glovebag operations; representative locations outside of the perimeter of a regulated area; inside clean room; and at the exhaust discharge point of local exhaust system ducted to the outside of a containment (if used). If the sampling outside regulated area shows airborne fiber levels have exceeded background or 0.01 f/cc, whichever is greater, work shall be stopped immediately, and the Contracting Officer notified. The condition causing the increase shall be corrected. Work shall not restart until authorized by the Contracting Officer.

3.7.6 Final Clearance Air Monitoring

Prior to conducting final clearance air monitoring, the Contractor and the Contracting Officer shall conduct a final visual inspection of the regulated area where asbestos abatement has been completed. The final visual inspection shall be as specified in SET-UP DETAIL SHEET 19. Final clearance air monitoring shall not begin until acceptance of the Contractor's final cleaning by the Contracting Officer. The Contractor's Designated IH shall conduct final clearance air monitoring using aggressive air sampling techniques as defined in EPA 560/5-85-024 or as otherwise required by federal or state requirements. The sampling and analytical method used will be NIOSH Pub No. 84-100 Method 7400 (PCM).

3.7.6.1 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH Pub No. 84-100 Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, shall be less than 0.01 f/cc. The abatement inside the regulated

area is considered complete when every PCM final clearance sample is below the clearance limit. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning shall be repeated.

Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.7.6.2 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, the Contractor shall pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

3.7.7 Air-Monitoring Results and Documentation

Air sample fiber counting shall be completed and results provided within 24 hours (breathing zone samples), and 24 hours (environmental/clearance monitoring) after completion of a sampling period. The Contracting Officer shall be notified immediately of any airborne levels of asbestos fibers in excess of established requirements. Written sampling results shall be provided within 5 working days of the date of collection. The written results shall be signed by testing laboratory analyst, testing laboratory principal and the Contractor's Designated IH. The air sampling results shall be documented on a Contractor's daily air monitoring log. The daily air monitoring log shall contain the following information for each sample:

- a. Sampling and analytical method used;
- b. Date sample collected;
- c. Sample number;
- d. Sample type: BZ = Breathing Zone (Personal), P = Preabatement, E = Environmental, C = Abatement Clearance;
- e. Location/activity/name where sample collected;
- f. Sampling pump manufacturer, model and serial number, beginning flow rate, end flow rate, average flow rate (L/min);
- g. Calibration date, time, method, location, name of calibrator, signature;
- h. Sample period (start time, stop time, elapsed time (minutes));
- i. Total air volume sampled (liters);
- j. Sample results (f/cc and S/mm square) if EPA methods are required for final clearance;
- k. Laboratory name, location, analytical method, analyst, confidence level. In addition, the printed name and a signature and date block for the Industrial Hygienist who conducted the sampling and for the Industrial Hygienist who reviewed the daily air monitoring

log verifying the accuracy of the information.

3.8 CLEARANCE CERTIFICATION

When asbestos abatement is complete, ACM waste is removed from the regulated areas, and final clean-up is completed, the Contracting Officer will certify the areas as safe before allowing the warning signs and boundary warning tape to be removed. The Contractor and the Contracting Officer shall visually inspect all surfaces within the containment for residual material or accumulated debris. The Contractor shall reclean all areas showing dust or residual materials. The Contracting Officer will certify in writing that the area is safe before unrestricted entry is permitted. The Government will have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.9 CLEANUP AND DISPOSAL

3.9.1 Title to ACM Materials

ACM material resulting from abatement work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified and in accordance with applicable federal, state and local regulations.

3.9.2 Collection and Disposal of Asbestos

All ACM waste shall be collected and including contaminated wastewater filters, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing, shall be collected and placed in leak-tight containers such as double plastic bags (see DETAIL SHEET 9A); sealed double wrapped polyethylene sheet (see DETAIL 9B); or other approved containers. Waste within the containers shall be wetted in case the container is breached. Asbestos-containing waste shall be disposed of at an EPA, state and local approved asbestos landfill off Government property. For temporary storage, sealed impermeable containers shall be stored in an asbestos waste load-out unit or in a storage/transportation conveyance (i.e., dumpster, roll-off waste boxes, etc.) in a manner acceptable to and in an area assigned by the Contracting Officer. Procedure for hauling and disposal shall comply with 40 CFR 61, Subpart M, state, regional, and local standards.

3.9.3 Scale Weight Measurement

Scales used for measurement shall be public scales. Weighing shall be at a point nearest the work at which a public scale is available. Scales shall be standard truck scales of the beam type; scales shall be equipped with the type registering beam and an "over and under" indicator; and shall be capable of accommodating the entire vehicle. Scales shall be tested, approved and sealed by an inspector of the State of HI. Scales shall be calibrated and resealed as often as necessary and at least once every three months to ensure continuous accuracy. Vehicles used for hauling ACM shall be weighed empty daily at such time as directed and each vehicle shall bear a plainly legible identification mark.

3.9.4 Weigh Bill and Delivery Tickets

Copies of weigh bills and delivery tickets shall be submitted to the Contracting Officer during the progress of the work. The Contractor shall furnish the Contracting Officer scale tickets for each load of ACM weighed and certified. These tickets shall include tare weight; identification mark for each vehicle weighed; and date, time and location of loading and unloading. Tickets shall be furnished at the point and time individual trucks arrive at the worksite. A master log of all vehicle loading shall be furnished for each day of loading operations. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified weigh bills and/or certified tickets and manifests of all ACM actually disposed by the Contractor for this contract.

3.9.5 Asbestos Waste Shipment Record

The Contractor shall complete and provide the Contracting Officer final completed copies of the Waste Shipment Record for all shipments of waste material as specified in 40 CFR 61, Subpart M and other required state waste manifest shipment records, within 3 days of delivery to the landfill.

Each Waste Shipment Record shall be signed and dated by the Contractor, the waste transporter and disposal facility operator.

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 1

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 01_____
2. LOCATION OF WORK TASK: Bldgs 845, 846, 847, 855, 876, and 876A,
SB Hawaii_____
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: 12 x 12 x 9 x 9
vinyl tile with asbestos mastic_____
 - a. Type of Asbestos: Chrysotile_____
 - b. Percent asbestos content: 2 - 5%_____
4. ABATEMENT TECHNIQUE TO BE USED: wet scrapping_____
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: II_____
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
Friable _____ Non-friable Category I _____
Non-friable Category II x_____
7. FORM _____ and CONDITION OF ACM: GOOD _____ FAIR _____ POOR _____
8. QUANTITY: METERS _____, SQUARE METERS _____
- 8a. QUANTITY: LINEAR FT. _____, SQUARE FT. _____
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK _____
10. SET-UP DETAIL SHEET NUMBERS
FOR WORK TASK 4, 9a 11, 12, 13, 14, 15, 57, 19. _____

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used in support of the response action (referenced in the selected

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
 Response Action Detail Sheet).

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 2

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 02_____
2. LOCATION OF WORK TASK: Bldgs 845, 846, 847, 855, 876, and 876A,
SB Hawaii
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: Transite panels

 - a. Type of Asbestos: Chrysotile
 - b. Percent asbestos content: 35%
4. ABATEMENT TECHNIQUE TO BE USED: wet method & remove intact
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: I
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
 Friable _____ Non-friable Category I _____
 Non-friable Category II x
7. FORM _____ and CONDITION OF ACM: GOOD _____ FAIR _____ POOR _____
8. QUANTITY: METERS _____, SQUARE METERS _____
- 8a. QUANTITY: LINEAR FT. _____, SQUARE FT. _____
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK _____
10. SET-UP DETAIL SHEET NUMBERS
 FOR WORK TASK 9a, 9b, 11, 12, 13, 14, 15, 19, 81.

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
 Condition: Good = G; Fair = F; Poor = P.

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used in support of the response action (referenced in the selected Response Action Detail Sheet).

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 3

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 03
2. LOCATION OF WORK TASK: Bldgs 845, 846, 847, 855, 876, and 876A, SB Hawaii
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: Pipe insulation wrap, joint sealant, pipe hanger insulation
 - a. Type of Asbestos: Chrysotile
 - b. Percent asbestos content: 2 - 5%
4. ABATEMENT TECHNIQUE TO BE USED: Glove bag - wet method
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: I
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
 Friable x Non-friable Category I _____
 Non-friable Category II _____
7. FORM _____ and CONDITION OF ACM: GOOD _____ FAIR _____ POOR _____
8. QUANTITY: METERS _____, SQUARE METERS _____
- 8a. QUANTITY: LINEAR FT. _____, SQUARE FT. _____
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK _____
10. SET-UP DETAIL SHEET NUMBERS
 FOR WORK TASK 9a, 10, 11, 12, 13, 14, 15, 19, 87.

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
 Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used in support of the response action (referenced in the selected

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
Response Action Detail Sheet).

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 4

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 04
2. LOCATION OF WORK TASK: Bldgs 845, 846, 847, 876A and 876, SB Hawaii
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: roofing mater, pipe sealant, flashing with silver paint
 - a. Type of Asbestos: Chrysotile
 - b. Percent asbestos content: 2 - 4%
4. ABATEMENT TECHNIQUE TO BE USED: wet method
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: II
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
 Friable Non-friable Category I
 Non-friable Category II x
7. FORM and CONDITION OF ACM: GOOD FAIR POOR
8. QUANTITY: METERS , SQUARE METERS
- 8a. QUANTITY: LINEAR FT. , SQUARE FT.
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK
10. SET-UP DETAIL SHEET NUMBERS
 FOR WORK TASK 9a, 11, 12, 13, 14, 15, 19, 74.

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
 Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used in support of the response action (referenced in the selected

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
Response Action Detail Sheet).

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 5

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 05
2. LOCATION OF WORK TASK: Bldgs 845 SB Hawaii

3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: Asbestos Flex Connectors
 - a. Type of Asbestos: Chrysotile
 - b. Percent asbestos content: 35%
4. ABATEMENT TECHNIQUE TO BE USED: wet method
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: I
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
 Friable x Non-friable Category I _____
 Non-friable Category II _____
7. FORM _____ and CONDITION OF ACM: GOOD _____ FAIR _____ POOR _____
8. QUANTITY: METERS _____, SQUARE METERS _____
- 8a. QUANTITY: LINEAR FT. _____, SQUARE FT. _____
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK _____
10. SET-UP DETAIL SHEET NUMBERS
 FOR WORK TASK 9a, 9b, 11, 12, 13, 14, 15, 19, 21, 104.

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
 Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
in support of the response action (referenced in the selected
Response Action Detail Sheet).

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet 1 of 6

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER : 06
2. LOCATION OF WORK TASK: Bldgs 845, 846, 847 & 855 SB, Hawaii
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: Cement pipe
exterior of Bldg
 - a. Type of Asbestos: Chrysotile
 - b. Percent asbestos content:
4. ABATEMENT TECHNIQUE TO BE USED: wet method
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK: I
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
Friable x Non-friable Category I
Non-friable Category II
7. FORM and CONDITION OF ACM: GOOD FAIR POOR
8. QUANTITY: METERS , SQUARE METERS
- 8a. QUANTITY: LINEAR FT. , SQUARE FT.
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK
10. SET-UP DETAIL SHEET NUMBERS
FOR WORK TASK 9a, 9b, 11, 12, 13, 14, 15, 19, 102.

NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
in support of the response action (referenced in the selected
Response Action Detail Sheet).

TABLE 2

FORMULA FOR CALCULATION OF THE 95 PERCENT CONFIDENCE LEVEL
(Reference: NIOSH 7400)

$$\text{Fibers/cc(01.95 percent CL)} = X + [(X) * (1.645) * (CV)]$$

Where: $X = ((E)(AC))/((V)(1000))$

$$E = ((F/Nf) - (B/Nb))/Af$$

CV = The precision value; 0.45 shall be used unless the analytical laboratory provides the Contracting Officer with documentation (Round Robin Program participation and results) that the laboratory's precision is better.

AC = Effective collection area of the filter in square millimeters

V = Air volume sampled in liters

E = Fiber density on the filter in fibers per square millimeter

F/Nf = Total fiber count per graticule field

B/Nb = Mean field blank count per graticule field

Af = Graticule field area in square millimeters

$$\text{TWA} = C1/T1 + C2/T2 = Cn/Tn$$

Where: C = Concentration of contaminant

T = Time sampled.

TABLE 3
 NIOSH METHOD 7400
 PCM ENVIRONMENTAL AIR SAMPLING PROTOCOL (NON-PERSONAL)

Sample Location	Minimum No. of Samples	Filter Pore Size (Note 1)	Min. Vol. (Note 2) (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	0.5/140 Square Meters (Notes 3 & 4)	0.45 microns	3850	2-16
Each Room in 1 Abatement Area Less than 140 Square meters		0.45 microns	3850	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.
2. Ensure detection limit for PCM analysis is established at 0.005 fibers/cc.
3. One sample shall be added for each additional 140 square meters. (The corresponding I-P units are 5/1500 square feet).
4. A minimum of 5 samples are to be taken per abatement area, plus 2 field blanks.

TABLE 4

EPA AHERA METHOD: TEM AIR SAMPLING PROTOCOL

Location Sampled	Minimum No. of Samples	Filter Pore Size	Min. Vol. (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	5	0.45 microns	1500	2-16
Outside Abatement Area	5	0.45 microns	1500	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.
2. The detection limit for TEM analysis is 70 structures/square mm.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME _____ CONTRACT NO. _____
 PROJECT ADDRESS _____
 CONTRACTOR FIRM NAME _____
 EMPLOYEE'S NAME _____, _____, _____,
 (Print) (Last) (First) (MI)

Social Security Number: _____-_____-_____,

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH TYPES OF LUNG DISEASE AND CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NONSMOKING PUBLIC.

Your employer's contract for the above project requires that you be provided and you complete formal asbestos training specific to the type of work you will perform and project specific training; that you be supplied with proper personal protective equipment including a respirator, that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you. The Contractor's Designated Industrial Hygienist will check the block(s) for the type of formal training you have completed. Review the checked blocks prior to signing this certification.

FORMAL TRAINING:

_____ a. For Competent Persons and Supervisors: I have completed EPA's Model Accreditation Program (MAP) training course, "Contractor/Supervisor", that meets this State's requirements.

b. For Workers:

_____ (1) For OSHA Class I work: I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

_____ (2) For OSHA Class II work (where there will be abatement of more than one type of Class II materials, i.e., roofing, siding, floor tile, etc.): I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

(3) For OSHA Class II work (there will only be abatement of one type of Class II material):

_____ (a) I have completed an 8-hour training class on the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls of 29 CFR 1926, Section .1101(g) and hands-on training.

_____ (b) I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

_____ (4) For OSHA Class III work: I have completed at least a 16-hour course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, Section .92(a)(2) and

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101, and hands-on training.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

_____ (5) For OSHA Class IV work: I have completed at least a 2-hr course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, (a)(1), and the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101(g) and hands-on training.

_____ c. Workers, Supervisors and the Designated Competent Person: I have completed annual refresher training as required by EPA's MAP that meets this State's requirements.

PROJECT SPECIFIC TRAINING:

_____ I have been provided and have completed the project specific training required by this Contract. My employer's Designated Industrial Hygienist and Designated Competent Person conducted the training.

RESPIRATORY PROTECTION:

_____ I have been trained in accordance with the criteria in the Contractor's Respiratory Protection program. I have been trained in the dangers of handling and breathing asbestos dust and in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair and contact lens use policy of my employer.

RESPIRATOR FIT-TEST TRAINING:

_____ I have been trained in the proper selection, fit, use, care, cleaning, maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the Contractor's Respiratory Program and have received a satisfactory fit. I have been assigned my individual respirator. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

MEDICAL EXAMINATION:

_____ I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made a determination regarding my physical capacity to perform work tasks on the project while wearing personal protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's Industrial Hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

_____ were no limitations to performing the required work tasks.
_____ were identified physical limitations to performing the required work tasks.

Date of the medical examination _____

Employee Signature _____ date _____

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

Contractor's Industrial

Hygienist Signature _____ date _____

-- End of Section --

APVG-GWV (200-1a)

MEMORANDUM FOR RECORD

Subject: Comprehensive Asbestos Survey for building SB 876

1. Enclosed is a final asbestos survey for subject above.
2. Questions pertaining to the survey can be directed to Russ Owens at 656-2878 ext. 1039.

Encl.

EDWARD LONG, P.E.
Asbestos Program Manager
Environmental Division, DPW

1.0 INTRODUCTION

The DPW Environmental Division performed a comprehensive survey for asbestos containing materials (ACM) for building 876 at Schofield Barracks on 25 August 1998 by Russell Owens, AHERA Planner, Certificate #5PSI102645, expiration date 19 February 1999. This includes all suspect materials on the interior, attic and crawl space where accessible.

1.1 Building Description

This building is used as a clinic and office.

1.2 Scope of Work for ACM Survey

The DPW, Environmental Division is to perform a comprehensive survey as part of an installation-wide plan to survey all buildings for asbestos.

1.3 Methods

ACM samples were collected according to the Asbestos Hazard Emergency Response Act (AHERA) regulations. The suspect materials were sent to NVL Laboratories, Inc. for analysis. NVL is an NVLAP accredited asbestos laboratory.

2.0 ASBESTOS INSPECTION

2.1 Sample Collection

Samples were taken from inconspicuous areas where available. The suspect ACM was first moistened, and then a sample was dislodged with a decontaminated collection tool, such as a chisel, utility knife, or screwdriver. The sample was then placed in a zip lock bag. The collection tool was decontaminated between samples to prevent cross-contamination. The area was then cleaned, and sealed with caulking, spray adhesive, or paint if the sample location was exposed. The homogeneous area, sample description, location, friability, substrate, estimated amount, and sample identification number were recorded on a sampling table. The sample identification number included the building number, homogeneous area, and sample number.

2.2 Sample Analysis

The samples were packaged and shipped with a chain-of-custody form to NVL Laboratories, Inc. in Seattle, WA.

2.3 Results

Results were interpreted as positive if a least one sample of homogeneous material was found to contain >1% asbestos fibers as per 40 CFR Part 61 Subpart M. The sampling data table is presented in Appendix A. The locations of the suspect ACM are shown in Appendix B. The analytical laboratory reports are found in Appendix C, Laboratory and inspector certificates are found in Appendix D.

The following table presents a summary of ACM based on the collection of bulk samples analyzed for asbestos.

Homogeneous Material ID	Material Description	Friable	Location	Estimated Amount	Results (ACM%)
M8	1) brown mastic 2) green vinyl tile 3) yellow mastic	No	hallway outside of waiting room	unable to measure	1) ND 2) 2% C 3) ND
M12	weathered gray tar sealant	No	around roof vents	30 LF	5% C

* Results will indicate the highest asbestos content if more than one sample were analyzed.

** ACM shown in bold face.

C: Chrysotile
A: Amosite
O: Others (Crocidolite, Tremolite, and Actinolite)

2.4 Disclaimer

Although the building was thoroughly inspected, the inspection does not implicitly guarantee that all ACM were identified because certain suspect materials may have been hidden or covered by walls, ceilings, floors, etc. If suspect materials are uncovered during demolition or renovation, the suspect materials shall not be disturbed until testing is done. The results obtained from this survey are only pertinent to materials present at the time of the survey and do not represent any materials subsequently installed or removed.

3.0 Addendum

This research was supported in part by an appointment to the Postgraduate Environmental Management Participation Program at the U.S. Army Environmental Center administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and USAEC.

Appendix A

Asbestos Sample Area Identification Table

ASBESTOS SAMPLING TABLE

Homogeneous Material ID	Material Description	Friable	Location	Sample ID	Results (ACM%)
M1	window caulk	No	window	SB-876-1-1	ND
				SB-876-1-2	ND
				SB-876-1-3	ND
M2	1) 12" white floor tile w/ gray and brown splotches 2) yellow mastic	No	waiting room	SB-876-2-1	1) ND 2) ND
				SB-876-2-2	1) ND 2) ND
				SB-876-2-3	1) ND 2) ND
M3	gypsum board	No	interior walls, ceiling	SB-876-3-1	ND
				SB-876-3-2	ND
				SB-876-3-3	ND
M4	2'x4' white ceiling tile with worm pattern	No	waiting room	SB-876-4-1	ND
				SB-876-4-2	ND
				SB-876-4-3	ND
M5	1) 12" tan floor tile with olive and white streaks 2) black/yellow mastic	No	office 1,2, & 3 storage room screening room 1,2, & 3	SB-876-5-1	1) ND 2) ND
				SB-876-5-2	1) ND 2) ND
				SB-876-5-3	1) ND 2) ND
M6	1) 12" light brown floor tile with brown and white streaks 2) brown/yellow mastic	No	bathroom, patches in reception room	SB-876-6-1	1) ND 2) ND
				SB-876-6-2	1) ND 2) ND
				SB-876-6-3	1) ND 2) ND
M7	12" white floor tile with white streaks	No	walkway in office 1 & 2	SB-876-7-1	ND
				SB-876-7-2	ND
				SB-876-7-3	ND
M8	1) brown mastic 2) green tile 3) yellow mastic	No	entrance to waiting room	SB-876-8-1	1) ND 2) 2% C 3) ND
				SB-876-8-2	NA
				SB-876-8-3	NA
M9	asphalt shingles with green and white stones	No	roof	SB-876-9-1	ND
				SB-876-9-2	ND
				SB-876-9-3	ND
M10	asphalt shingles with white stones	No	roof	SB-876-10-1	ND
				SB-876-10-2	ND
				SB-876-10-3	ND
M11	tar paper	No	roof	SB-876-11-1	ND
				SB-876-11-2	ND
				SB-876-11-3	ND
M12	weathered gray tar sealant	No	around roof vents	SB-876-12-1	5% C
				SB-876-12-2	NA
				SB-876-12-3	NA
M13	off white adhesive	No	waiting room	SB-876-13-1	ND
				SB-876-13-2	ND
				SB-876-13-3	ND

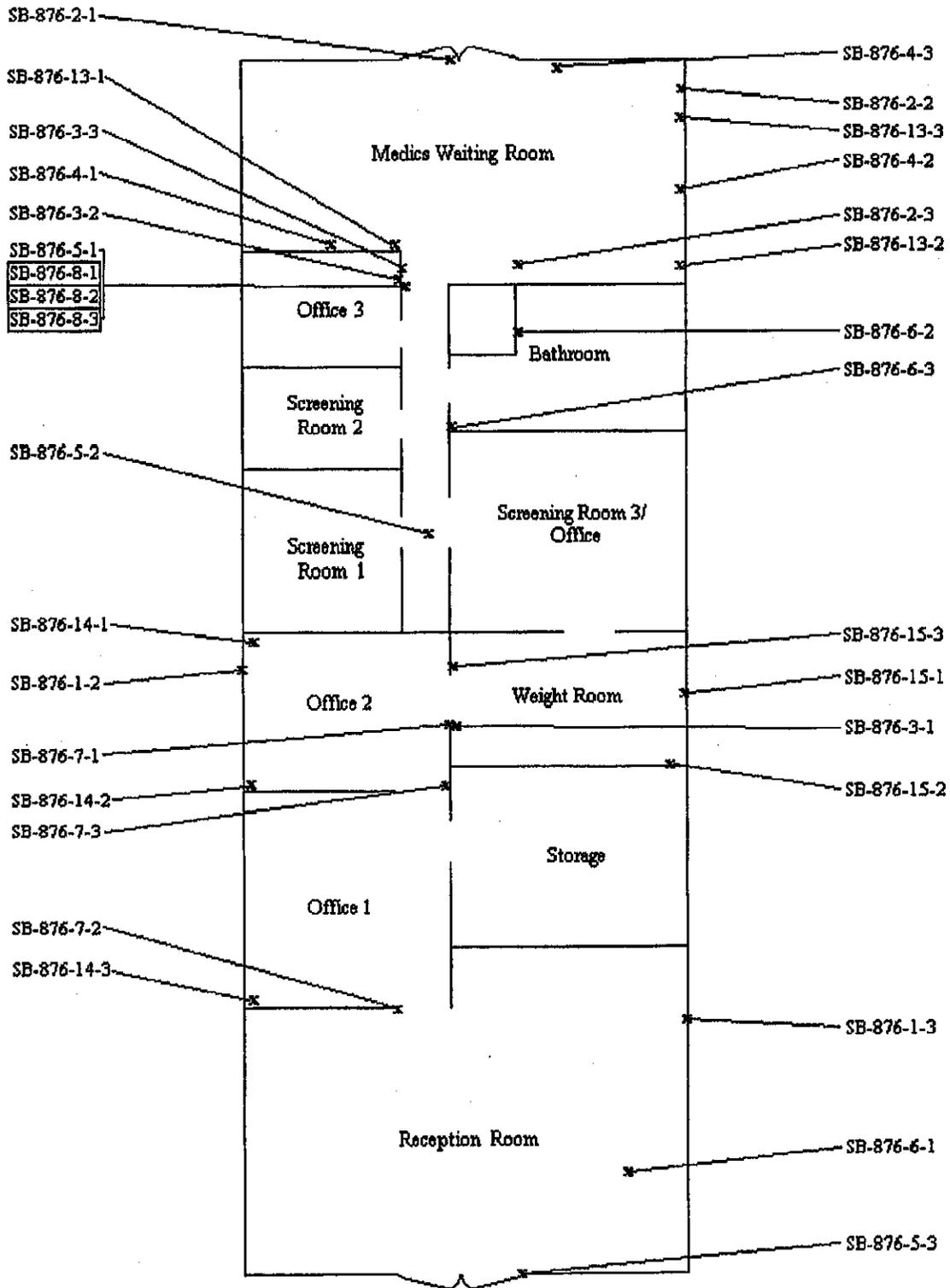
Homogeneous Material ID	Material Description	Friable	Location	Sample ID	Results (ACM%)
M14	yellow adhesive	No	floors of office 1, 2	SB-876-14-1	ND
				SB-876-14-2	ND
				SB-876-14-3	ND
M15			walls of office 1 & 2, weight room, storage room, reception room	SB-876-15-1	ND
				SB-876-15-2	ND
				SB-876-15-3	ND

* ACM shown in bold face

- C: Chrysotile
- A: Amosite
- ND: None detected
- O: Others (Crocidolite, Tremolite, and Actinolite)
- T: Top layer
- M: Middle layer
- B: Bottom layer
- NA: Not analyzed
- N/A: Not applicable

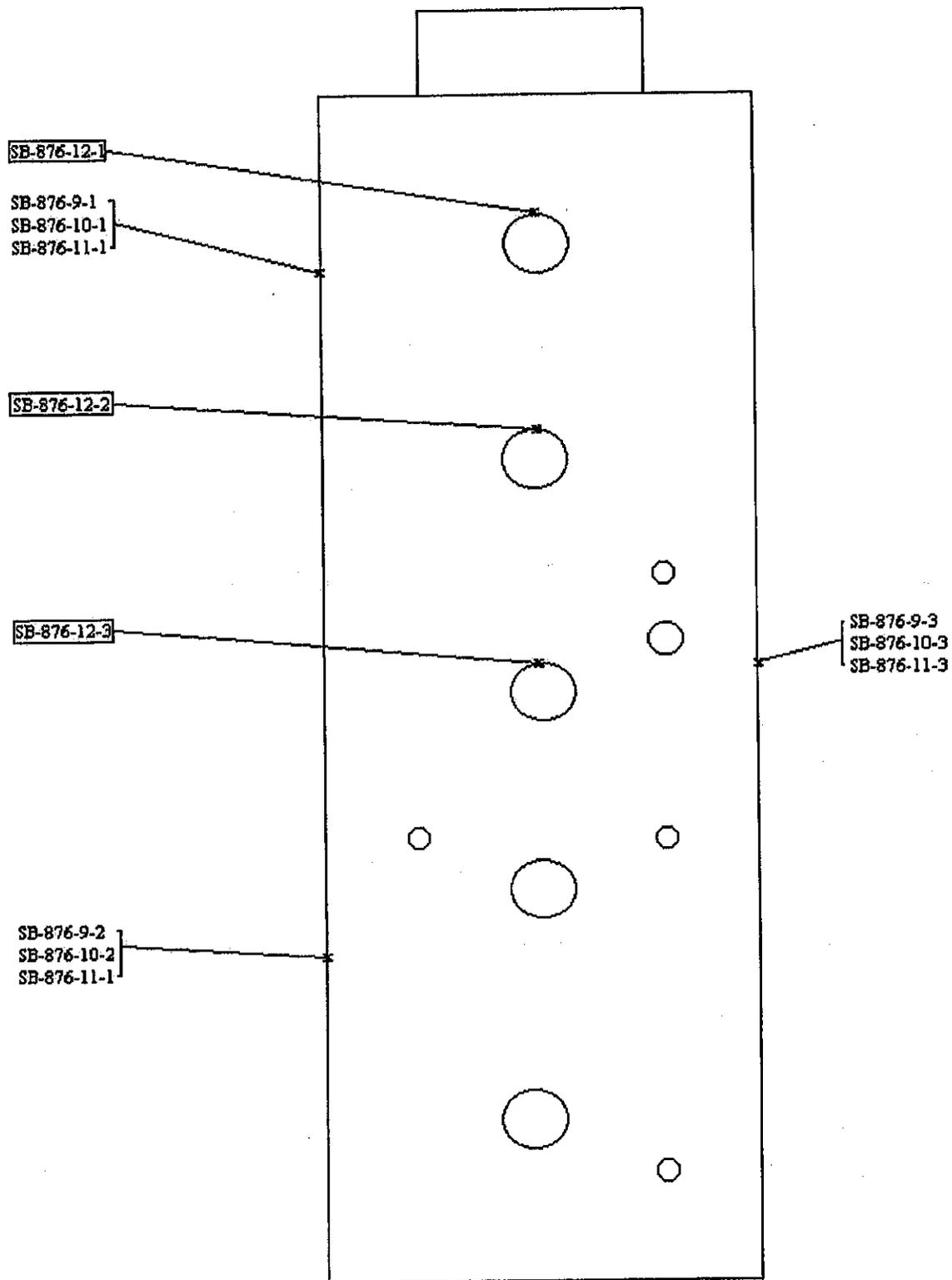
Appendix B

Sample Locations



SB 876 - Floor Plan

Not to Scale



SB 876 - Roof Plan

Sample ID # = ACM

Not to Scale

Appendix C

Asbestos Analytical Laboratory Results

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100

Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP

#102063

Client: Directorate of Public Works
 Address: Environmental Division Schofield
 Barracks, APZG-GWY
 Wahiawa, HI 98757-5000
 Attn.: Gary Takahashi
 Project: Schofield Barracks

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Lab ID #: 98091368 Client Sample #: SB-876-1-1

Sample Location: Schofield Barracks

Description: Off-white molded brittle material with yellow paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 98091369 Client Sample #: SB-876-1-2

Sample Location: Schofield Barracks

Description: Off-white molded brittle material with yellow paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 98091370 Client Sample #: SB-876-1-3

Sample Location: Schofield Barracks

Description: Off-white molded brittle material with yellow paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 09/14/1998

Date: 09/14/1998


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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4708 Aurora Ave. N., Seattle, WA 98103

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield BarracksNVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091371 Client Sample #: SB-876-2-1

Sample Location: Schofield Barracks

Description: LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 1%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091372 Client Sample #: SB-876-2-2

Sample Location: Schofield Barracks

Description: LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 1%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091373 Client Sample #: SB-876-2-3

Sample Location: Schofield Barracks

Description: LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 1%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Mastic/binder

(Sample results are continued on the next page.)

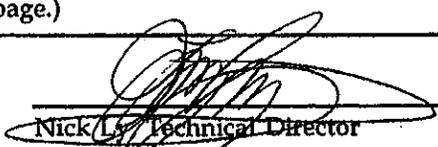
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 09/14/1998

Date: 09/14/1998


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Address: Environmental Division Schofield
 Barracks, APZG-GWY
 Wahiawa, HI 98757-5000
 Attn.: Gary Takahashi
 Project: Schofield Barracks

NVL Batch Number: 98-7787

Client Project #: 980901-2
 Number of samples: 41

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091374 Client Sample #: SB-876-3-1
 Sample Location: Schofield Barracks
 Description: White chalky material with tan fibrous material and white paint

OTHER FIBROUS MATERIALS:
 Cellulose 25%

NON-FIBROUS MATERIALS:
 Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 98091375 Client Sample #: SB-876-3-2
 Sample Location: Schofield Barracks
 Description: White chalky material with tan fibrous material and white paint

OTHER FIBROUS MATERIALS:
 Cellulose 25%

NON-FIBROUS MATERIALS:
 Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 98091376 Client Sample #: SB-876-3-3
 Sample Location: Schofield Barracks
 Description: White chalky material with tan fibrous material and white paint

OTHER FIBROUS MATERIALS:
 Cellulose 25%

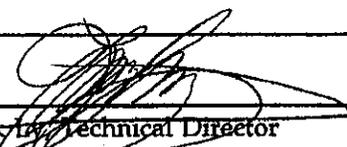
NON-FIBROUS MATERIALS:
 Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 09/14/1998
 Date: 09/14/1998


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Directorate of Public Works
Address: Environmental Division Schofield Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield Barracks

NVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

***None Detected**

ND

Lab ID #: 98091377 **Client Sample #:** SB-876-4-1
Sample Location: Schofield Barracks
Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
Cellulose 65%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 98091378 **Client Sample #:** SB-876-4-2
Sample Location: Schofield Barracks
Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
Cellulose 65%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 98091379 **Client Sample #:** SB-876-4-3
Sample Location: Schofield Barracks
Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
Cellulose 65%

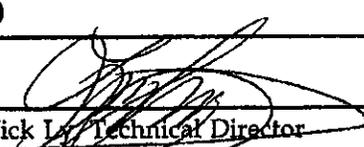
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 09/14/1998
Date: 09/14/1998


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Address: Environmental Division Schofield
 Barracks, APZG-GWY
 Wahiawa, HI 98757-5000
 Attn.: Gary Takahashi
 Project: Schofield Barracks

NVL Batch Number: 98-7787
 Client Project #: 980901-2
 Number of samples: 41

Lab ID #: 98091380 Client Sample #: SB-876-5-1

Sample Location: Schofield Barracks
 Description: LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%, Polyethylene 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091381 Client Sample #: SB-876-5-2

Sample Location: Schofield Barracks
 Description: LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%, Polyethylene 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091382 Client Sample #: SB-876-5-3

Sample Location: Schofield Barracks
 Description: LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%, Polyethylene 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Mastic/binder

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 09/14/1998
 Date: 09/14/1998


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield Barracks

NVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091383 Client Sample #: SB-876-6-1
Sample Location: Schofield Barracks
Description: LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:
LAYER 1: Vinyl/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091384 Client Sample #: SB-876-6-2
Sample Location: Schofield Barracks
Description: LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%

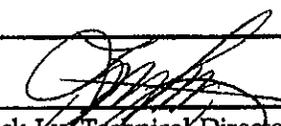
NON-FIBROUS MATERIALS:
LAYER 1: Vinyl/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 09/14/1998
Date: 09/14/1998


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Client: Directorate of Public Works
 Address: Environmental Division Schofield
 Barracks, APZG-GWY
 Wahiawa, HI 98757-5000
 Attn.: Gary Takahashi
 Project: Schofield Barracks

NVL Batch Number: 98-7787
 Client Project #: 980901-2
 Number of samples: 41

Lab ID #: 98091385 Client Sample #: SB-876-6-3

Sample Location: Schofield Barracks

Description: LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 98091386 Client Sample #: SB-876-7-1

Sample Location: Schofield Barracks

Description: White vinyl tile

OTHER FIBROUS MATERIALS:

*None Detected

NON-FIBROUS MATERIALS:

Vinyl/binder, Granules

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 98091387 Client Sample #: SB-876-7-2

Sample Location: Schofield Barracks

Description: White vinyl tile

OTHER FIBROUS MATERIALS:

*None Detected

NON-FIBROUS MATERIALS:

Vinyl/binder, Granules

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

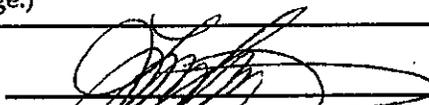
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 09/14/1998

Date: 09/14/1998


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/115 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
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Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield Barracks

NVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091388 Client Sample #: SB-876-7-3
Sample Location: Schofield Barracks
Description: White vinyl tile

OTHER FIBROUS MATERIALS:
*None Detected

NON-FIBROUS MATERIALS:
Vinyl/binder, Granules

ASBESTOS TYPE: PERCENT
*None Detected ND

Lab ID #: 98091389 Client Sample #: SB-876-8-1

Sample Location: Schofield Barracks
Description: LAYER 1: Brown mastic material with white powdery material, LAYER 2: Green vinyl tile, LAYER 3: Yellow mastic material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 5%
LAYER 2: Cellulose 1%
LAYER 3: Cellulose 2%

NON-FIBROUS MATERIALS:
LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules
LAYER 3: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: Chrysotile 2%
LAYER 3: *None Detected ND

Lab ID #: 98091392 Client Sample #: SB-876-9-1

Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules

OTHER FIBROUS MATERIALS:
Glass fibers 20%

NON-FIBROUS MATERIALS:
Asphalt/binder, Sand/binder

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 09/14/1998
Date: 09/14/1998


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield BarracksNVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41***None Detected****ND**

Lab ID #: 98091393 Client Sample #: SB-876-9-2

Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules**OTHER FIBROUS MATERIALS:**

Glass fibers 20%

ASBESTOS TYPE:***None Detected****NON-FIBROUS MATERIALS:**

Asphalt/binder, Sand/binder

PERCENT**ND**

Lab ID #: 98091394 Client Sample #: SB-876-9-3

Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules**OTHER FIBROUS MATERIALS:**

Glass fibers 20%

ASBESTOS TYPE:***None Detected****NON-FIBROUS MATERIALS:**

Asphalt/binder, Sand/binder

PERCENT**ND**

Lab ID #: 98091395 Client Sample #: SB-876-10-1

Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules**OTHER FIBROUS MATERIALS:**

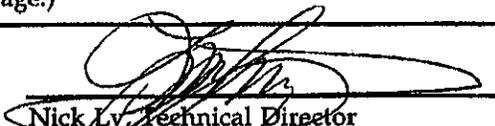
Glass fibers 20%

ASBESTOS TYPE:***None Detected****NON-FIBROUS MATERIALS:**

Asphalt/binder, Sand/binder

PERCENT**ND**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 09/14/1998
Date: 09/14/1998
Nick Ly, Technical Director

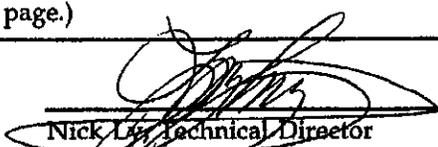
Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield BarracksNVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41Lab ID #: 98091396 Client Sample #: SB-876-10-2
Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules**OTHER FIBROUS MATERIALS:**
Glass fibers 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Asphalt/binder, Sand/binder
PERCENT
NDLab ID #: 98091397 Client Sample #: SB-876-10-3
Sample Location: Schofield Barracks
Description: Black asphaltic material with multi-colored granules**OTHER FIBROUS MATERIALS:**
Glass fibers 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Asphalt/binder, Sand/binder
PERCENT
NDLab ID #: 98091398 Client Sample #: SB-876-11-1
Sample Location: Schofield Barracks
Description: Black tar paper**OTHER FIBROUS MATERIALS:**
Cellulose 55%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Asphalt/binder, Binder & filler
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 09/14/1998
Date: 09/14/1998
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield BarracksNVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091399 Client Sample #: SB-876-11-2

Sample Location: Schofield Barracks
Description: Black tar paper**OTHER FIBROUS MATERIALS:**

Cellulose 55%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Binder & filler

PERCENT

ND

Lab ID #: 98091400 Client Sample #: SB-876-11-3

Sample Location: Schofield Barracks
Description: Black tar paper**OTHER FIBROUS MATERIALS:**

Cellulose 55%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Binder & filler

PERCENT

ND

Lab ID #: 98091401 Client Sample #: SB-876-12-1

Sample Location: Schofield Barracks
Description: Black asphaltic material**OTHER FIBROUS MATERIALS:**

Cellulose 3%

ASBESTOS TYPE:

Chrysotile

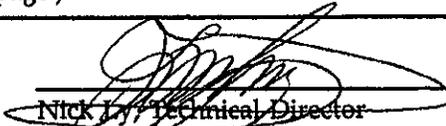
NON-FIBROUS MATERIALS:

Asphalt/binder

PERCENT

5%

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 09/14/1998
Date: 09/14/1998
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield Barracks

NVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091404 Client Sample #: SB-876-13-1

Sample Location: Schofield Barracks
Description: White soft material with white/blue paint

OTHER FIBROUS MATERIALS:
Cellulose 2%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 98091405 Client Sample #: SB-876-13-2

Sample Location: Schofield Barracks
Description: White soft material with blue paint

OTHER FIBROUS MATERIALS:
Cellulose 2%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 98091406 Client Sample #: SB-876-13-3

Sample Location: Schofield Barracks
Description: White soft material

OTHER FIBROUS MATERIALS:
Cellulose 3%

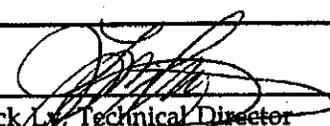
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 09/14/1998
Date: 09/14/1998


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield BarracksNVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091407 Client Sample #: SB-876-14-1

Sample Location: Schofield Barracks
Description: Yellow adhesive material**OTHER FIBROUS MATERIALS:**

Cellulose 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Adhesive/binder

PERCENT

ND

Lab ID #: 98091408 Client Sample #: SB-876-14-2

Sample Location: Schofield Barracks
Description: Yellow adhesive material**OTHER FIBROUS MATERIALS:**

Cellulose 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Adhesive/binder

PERCENT

ND

Lab ID #: 98091409 Client Sample #: SB-876-14-3

Sample Location: Schofield Barracks
Description: Yellow adhesive material**OTHER FIBROUS MATERIALS:**

Cellulose 4%

ASBESTOS TYPE:

*None Detected

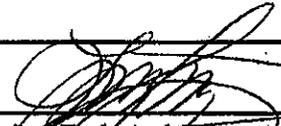
NON-FIBROUS MATERIALS:

Adhesive/binder

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 09/14/1998
Date: 09/14/1998
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000
Attn.: Gary Takahashi
Project: Schofield Barracks

NVL Batch Number: 98-7787
Client Project #: 980901-2
Number of samples: 41

Lab ID #: 98091410 Client Sample #: SB-876-15-1

Sample Location: Schofield Barracks
Description: Tan adhesive material

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Adhesive/binder

PERCENT

ND

Lab ID #: 98091411 Client Sample #: SB-876-15-2

Sample Location: Schofield Barracks
Description: Tan adhesive material

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Adhesive/binder

PERCENT

ND

Lab ID #: 98091412 Client Sample #: SB-876-15-3

Sample Location: Schofield Barracks
Description: Tan adhesive material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

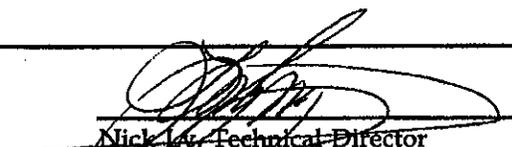
Adhesive/binder, Paint

PERCENT

ND

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 09/14/1998
Date: 09/14/1998


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for reported % Asbestos: 1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%. This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Summary Report
Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Lab #: 98091368 Client's #: SB-876-1-1

Sample description:
Off-white molded brittle material with yellow paint

ASBESTOS TYPE	PERCENT
*None Detected	ND

Lab #: 98091369 Client's #: SB-876-1-2

Sample description:
Off-white molded brittle material with yellow paint

ASBESTOS TYPE	PERCENT
*None Detected	ND

Lab #: 98091370 Client's #: SB-876-1-3

Sample description:
Off-white molded brittle material with yellow paint

ASBESTOS TYPE	PERCENT
*None Detected	ND

Lab #: 98091371 Client's #: SB-876-2-1

Sample description:
LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

ASBESTOS TYPE	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab #: 98091372 Client's #: SB-876-2-2

Sample description:
LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

ASBESTOS TYPE	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab #: 98091373 Client's #: SB-876-2-3

Sample description:
LAYER 1: Off-white vinyl tile, LAYER 2: Yellow mastic material

ASBESTOS TYPE	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab #: 98091374 Client's #: SB-876-3-1

Sample description:
White chalky material with tan fibrous material and white paint

ASBESTOS TYPE	PERCENT
*None Detected	ND

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Summary Report
Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Lab #:98091375 Client's #: SB-876-3-2

Sample description:

White chalky material with tan fibrous material and white paint

ASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #:98091376 Client's #: SB-876-3-3

Sample description:

White chalky material with tan fibrous material and white paint

ASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #:98091377 Client's #: SB-876-4-1

Sample description:

Gray fibrous material with white paint

ASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #:98091378 Client's #: SB-876-4-2

Sample description:

Gray fibrous material with white paint

ASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #:98091379 Client's #: SB-876-4-3

Sample description:

Gray fibrous material with white paint

ASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #:98091380 Client's #: SB-876-5-1

Sample description:

LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic material

ASBESTOS TYPE
LAYER 1: *None Detected
LAYER 2: *None DetectedPERCENT
ND
ND

Lab #:98091381 Client's #: SB-876-5-2

Sample description:

LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic material

ASBESTOS TYPE
LAYER 1: *None Detected
LAYER 2: *None DetectedPERCENT
ND
ND

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

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Fax: 206.634.1936**Summary Report
Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Lab #: 98091382 Client's #: SB-876-5-3
Sample description:
LAYER 1: Tan vinyl tile, LAYER 2: Black/yellow mastic materialLab #: 98091385 Client's #: SB-876-6-3
Sample description:
LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic materialASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected NDASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected NDLab #: 98091383 Client's #: SB-876-6-1
Sample description:
LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic materialLab #: 98091386 Client's #: SB-876-7-1
Sample description:
White vinyl tileASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected NDASBESTOS TYPE PERCENT
*None Detected NDLab #: 98091384 Client's #: SB-876-6-2
Sample description:
LAYER 1: Light brown vinyl tile, LAYER 2: Brown/yellow mastic materialLab #: 98091387 Client's #: SB-876-7-2
Sample description:
White vinyl tileASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected NDASBESTOS TYPE PERCENT
*None Detected NDLab #: 98091388 Client's #: SB-876-7-3
Sample description:
White vinyl tileASBESTOS TYPE PERCENT
*None Detected ND

NVL Laboratories, Inc.

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Tel: 206.547.0100
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**Summary Report
Bulk Asbestos Fiber Analysis**

NVLAP
#102063

Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Lab #:98091394 Client's #: SB-876-9-3

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091389 Client's #: SB-876-8-1

Sample description:
LAYER 1: Brown mastic material with white powdery material,
LAYER 2: Green vinyl tile, LAYER 3: Yellow mastic material

ASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: Chrysotile 2%
LAYER 3: *None Detected ND

Lab #:98091395 Client's #: SB-876-10-1

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091392 Client's #: SB-876-9-1

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091396 Client's #: SB-876-10-2

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091393 Client's #: SB-876-9-2

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091397 Client's #: SB-876-10-3

Sample description:
Black asphaltic material with multi-colored granules

ASBESTOS TYPE PERCENT
*None Detected ND

DRAFT

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Summary Report
Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Chrysotile

5%

Lab #: 98091398

Client's #: SB-876-11-1

Sample description:
Black tar paperASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091404

Client's #: SB-876-13-1

Sample description:
White soft material with white/blue paintASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091399

Client's #: SB-876-11-2

Sample description:
Black tar paperASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091405

Client's #: SB-876-13-2

Sample description:
White soft material with blue paintASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091400

Client's #: SB-876-11-3

Sample description:
Black tar paperASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091406

Client's #: SB-876-13-3

Sample description:
White soft materialASBESTOS TYPE
*None DetectedPERCENT
ND

Lab #: 98091401

Client's #: SB-876-12-1

Sample description:
Black asphaltic material

ASBESTOS TYPE

PERCENT

Analyzed by: Wei Long Tai

Date: 09/14/1998

Page 5

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
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Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Directorate of Public Works
Address: Environmental Division Schofield
Barracks, APZG-GWY
Wahiawa, HI 98757-5000

NVL Batch Number: 98-7787

Client Project #: 980901-2

Number of samples: 41

Attn.: Gary Takahashi

Project: Schofield Barracks

Lab #:98091407 Client's #: SB-876-14-1

Sample description:
Yellow adhesive materialASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091411 Client's #: SB-876-15-2

Sample description:
Tan adhesive materialASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091408 Client's #: SB-876-14-2

Sample description:
Yellow adhesive materialASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091412 Client's #: SB-876-15-3

Sample description:
Tan adhesive material with white paintASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091409 Client's #: SB-876-14-3

Sample description:
Yellow adhesive materialASBESTOS TYPE PERCENT
*None Detected ND

Lab #:98091410 Client's #: SB-876-15-1

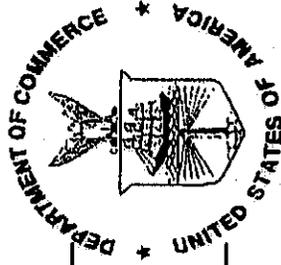
Sample description:
Tan adhesive materialASBESTOS TYPE PERCENT
*None Detected ND

Appendix D

Laboratory and Inspector Certificates

United States Department of Commerce
National Institute of Standards and Technology

NVLAP[®]



ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

NVL LABORATORIES, INC.
SEATTLE, WA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

BULK ASBESTOS FIBER ANALYSIS

September 30, 1998

Effective through

For the National Institute of Standards and Technology

NVLAP Lab Code: 102063-0

PSI Professional Service Industries, Inc.

Asbestos Inspector Refresher Training Course

Russ Owens

203-64-9986

has successfully completed a 4-hour EPA-Approved Asbestos Inspector Refresher Training Course for purposes of accreditation required under Section 206 of Title II of the Toxic Substances Control Act (TSCA). Conducted by Professional Service Industries, 510 E. 22nd St., Lombard, IL, 60148, 800-426-2897/913-749-2381. Continuing Education Units Awarded: .4



The Continuing

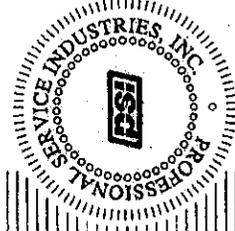
Education Unit ©

Location: Honolulu, Hawaii

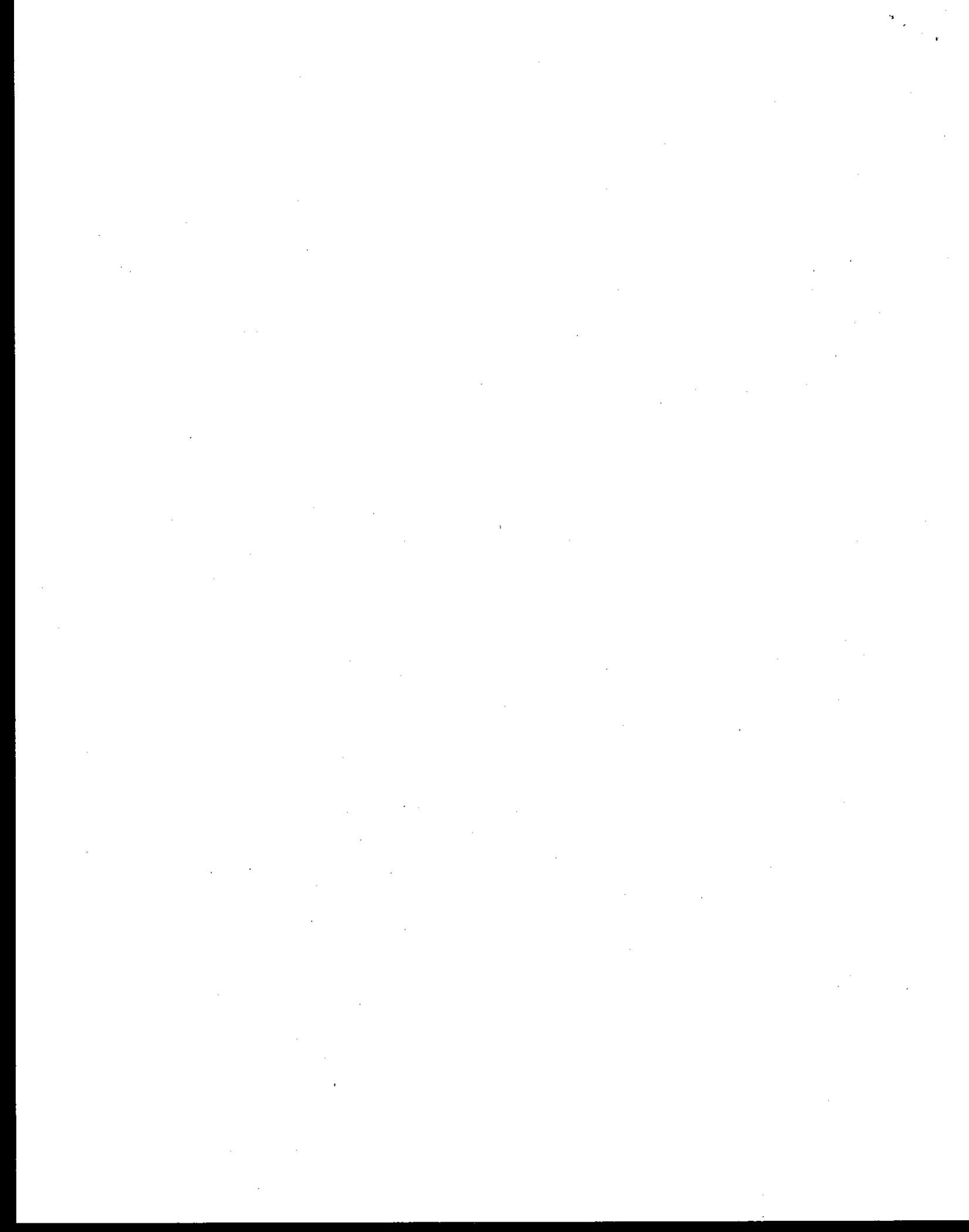
Expiration: February 19, 1999

Course: February 19, 1998

Director of Training



Certificate Number 5PSI 102645 IR



FINAL

VOLUME II

(Buildings T-754, T-756, T-758, T-759, 845 and 846)

**The Demolition Survey Report:
Underground Storage Tank, PCB Ballast,
Asbestos and Lead Paint Inspection
Buildings 747, T-754, T-756, T-758, T-759,
845, 846
Option 1: Buildings 847, 844, T-876 & T-876A
Schofield Barracks, Island of Oahu, Hawaii**

**Contract No: DACA83-00-D-0007
Task Order No. 0003**

**PREPARED FOR:
U. S. Army Corps of Engineers
Pacific Ocean Division
Fort Shafter, Oahu, Hawaii**

**PREPARED BY:
Fung Associates
1833 Kalakaua Avenue, Suite 1008
Honolulu, Hawaii 96815**

**In Collaboration with:
Edward K. Noda and Associates, Inc.
615 Piikoi Street, Suite 300
Honolulu, Hawaii 96814**

May 2001

This report is divided into two separate volumes as follows:

Volume I: Building 747 (Quad I)

Part 1: Asbestos and Lead Paint Inspection Report
prepared by Edward K. Noda and Associates, Inc.

Part 2-A: PCB Ballast Inspection Report
prepared by Fung Associates

Part 2-B: UST Inspection Report
prepared by Fung Associates

**Volume II: Buildings T-754, T-756, T-758, T-759
Buildings 845 and 846 (Quad J)**

Part 1: Asbestos and Lead Paint Inspection Report
prepared by Edward K. Noda and Associates, Inc.

Part 2-A: PCB Ballast Inspection Report
prepared by Fung Associates

Part 2-B: UST Inspection Report
prepared by Fung Associates

Part 1

**Asbestos and Lead Paint Inspection Report
by Edward K. Noda and Associates, Inc.**

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I. EXECUTIVE SUMMARY

Edward K. Noda & Associates, Inc. (EKNA) was retained by Fung Associates, 1833 Kalakaua Avenue, Honolulu, Hawaii, to conduct an investigative asbestos survey of buildings T-754, T-756, T-758, T-759, 845 and 846, Schofield Barracks, Island of Oahu, Hawaii, for visible and accessible asbestos-containing building materials (ACBM) which may be required to be abated prior to any renovation/demolition activities, and Toxicity Characteristic Leaching Procedure (TCLP) testing.

EKNA's certified asbestos inspectors William Harris and Doug Tidsell conducted an investigative survey from July 19th thru August 9th, 2000. EKNA collected five hundred eight (508) suspect asbestos-containing building material (ACBM) samples and identified one hundred thirty two (132) distinct material types from Buildings T-754, T-756, T-758, T-759, 845 and 846.

TCLP analytical results indicate that expected generated demolition debris Buildings T-754, T-756, T-758, T-759, 845 and 846, Schofield Barracks, is not considered hazardous waste and may be disposed of as general construction debris.

The investigative asbestos survey found the following ACBM in the following buildings. Materials found to contain greater than one percent asbestos are indicated in **bold print** (an asterisk indicates a friable material).

Building T-754

NO ACBM IDENTIFIED

Building T-756

NO ACBM IDENTIFIED

Building T-758

Drain Pipe Sealant - Black Asphaltic Soft Material
Roof Sealant - Black Asphaltic Material with Gray Surface

Building T-759

***Window Caulking - Off-White Brittle Molded Material with Cream Paint**

Building 845

12" x 12" Tan with Brown Streaks Vinyl Floor Tile with Mastic - Black
12" x 12" Beige with Brown Streaks Vinyl Floor Tile with Mastic - Black

12" x 12" Beige with Grey Marbling Vinyl Floor Tile with Mastic - *Black*
12" x 12" Brown Vinyl Floor Tile with Mastic - *Black*
12" x 12" Off White Chalk Vinyl Floor Tile with Mastic - *Black*
12" x 12" Olive Green with Black Streaks Vinyl Floor Tile with Mastic - *Black*
12" x 12" Medium Brown with Streaks Vinyl Floor Tile with Mastic - *Black*
12" x 12" Grey/Green Marbled Vinyl Floor Tile with Mastic - *Black*
12" x 12" Brown with Dark Brown Spots Vinyl Floor Tile with Mastic - *Black*
Plaster with Skim Coat - *<1% Gray Paint (1 sample only)*
Cementitious Panels - Eaves - *Grey Cementitious Asbestos Board*
*Flashing - Main Roof at Flue/Stack - *Silver Paint*
*Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White Calcareous Matrix*
*Chilled Water Supply - Hanger - *White Insulation - Off White Soft Material with Paint*
*Chilled Water Supply - Fitting - *Off White Soft Material with Paint*
*HVAC Vibration Cloth - *White Woven Material - White Fibrous Material*
*Pipe Hanger Insulation - Chilled Water - *White Soft Material*
*Hot Water Pipe Insulation - Elbow - *White Coating*
*Pipe Hanger Insulation - Chilled Water - *White Soft Material*

Building 846

12" x 12" Brown Vinyl Floor Tile with Mastic - *Black*
12" x 12" Cocoa Brown Streaks Vinyl Floor Tile with Mastic - *Black*
12" x 12" Brown with Orange Streaks Vinyl Floor Tile with Mastic - *Black*
12" x 12" Grey with Beige Marbling Vinyl Floor Tile with Mastic - *Black*
12" x 12" Olive Green Vinyl Floor Tile with Mastic - *Black*
12" x 12" Tan with Brown Streaks Vinyl Floor Tile with Mastic - *Black*
12" x 12" Blue Gray with White Marbling Vinyl Floor Tile with Mastic - *Black*
Flashing with Grey Sealant - *At Roof Flues*
Cementitious Panels - Eaves - *Grey Cementitious Asbestos Board - Assumed w/o sampling*

First, Second & Third Floor Plenums

*Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White fine calcareous matrix*

Exterior

Transite Pipe

II. INTRODUCTION

The objective of this survey was to assess the existence and extent of ACBM in Buildings T-754, T-756, T-758, T-759, 845 and 846 Schofield Barracks, which are scheduled to be renovated/demolished.

EKNA's scope of work included an investigative asbestos survey, collection and testing of suspect asbestos-containing material samples, and provide a written report summarizing the survey with test results for Buildings T-754, T-756, T-758, T-759, 845 and 846 at Schofield Barracks.

Buildings 845 and 846 are 3-story concrete structures which provide office space on the first floor, and living quarters on the second and third floors. The primary hot water heaters for Buildings 845 and 846 are located on each of the building first floors. Buildings 845 and 846 share the same chiller plant, located in Building 845.

Building T-754 is a slab on grade structure comprised of wood and steel beams with painted metal corrugated siding and roofing. The building was formerly utilized as warehouse and motor pool and is currently occupied by the MOSIT Center, Unit Armorer School and Artillery Training.

Building T-756 is slab on grade construction and built of corrugated siding and roofing. The building is currently occupied by HHB DIVARTY Storage, 25th FAD, and HHB DIVARTY Fire Support Office and utilized to store and repair equipment

Building T-758 is slab on grade construction, built of prefabricated metal. The building is utilized as motor pool training center.

Building T-759 is an open front, motor pool building, slab on grade construction and built of prefabricated metal.

III. SURVEY METHODOLOGY

From July 19th thru August 9th, 2000, EKNA's certified inspectors William Harris and Doug Tisdell (see Appendix G for Inspector Certificates) conducted an investigative survey of accessible building materials for the presence of suspect ACBM. During the survey five hundred eight (508) suspect ACBM samples were collected from one hundred thirty two (132) distinct material types in Buildings T-754, T-756, T-758, T-759, 845 and 846 (see Table 1 for per building breakdown).

Table 1

Building Number	Samples Collected	Homogeneous Material Identified
T-754	48	17
T-756	16	7
T-758	10	5
T-759	5	3
845	217	51
846	212	49
TOTAL	508	132

AHERA is the federal law (40 CFR 763) instituted to regulate asbestos in schools. In addition to AHERA, the EPA has issued a document titled "Guidance for Controlling Asbestos-Containing Materials in Buildings" (Document number EPA 560/5-85-024) for buildings which are not governed by AHERA legislation. During an asbestos assessment, one of the most important characteristics of a material that AHERA & EPA addresses is "friability". AHERA describes "friable" as those materials that when dry may be crumbled, pulverized, or reduced to powder by hand pressure. The term includes previously non-friable material after it becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure. In addition, AHERA regulations require that for any homogenous sampled material (i.e., materials with similar location, function, thickness and color), if one sample of a given material tests positive for asbestos (greater than one percent asbestos), the entire homogenous material is considered positive for asbestos.

AHERA regulations require that for an Homogeneous Sampling Material (HSM), if one sample tests positive for asbestos, the entire HSM type is considered asbestos-containing. For this reason, EKNA directs the laboratory to stop analysis at the first positive result (asbestos content in excess of one percent) for each homogeneous material type, if more than one sample is presented for an HSM.

The appearance of each material and date of installation were considered to ensure that materials known to have been installed at different times would be sampled as a separate HSM.

After completing an inventory of building materials, EKNA collected samples of each suspect material. Drawings are provided in each applicable appendices that depict the locations of all samples collected.

The number of samples collected was determined by the extent of HSM within the building space, in accordance with the sampling protocol contained in 40 CFR 763. HSM is analogous to the homogeneous area as defined by 40 CFR 763. In general, an HSM is identified as that area or amount of suspect ACM which is uniform in color and texture. For example, the pipe runs of a domestic hot water system would be a single HSM provided that the material does not differ in appearance, color, or texture throughout the system. When a system or area appears to consist of dissimilar materials, then the system or area is separated into as many HSMs as necessary to define all suspect materials present.

If two HSM are similar in appearance or texture and cannot be described uniquely, a type number is assigned to differentiate them. For example, if distinct but HSM are similar in appearance, the first is identified as Type I and the second as Type II (e.g., Brown 12"x12" Vinyl Floor Tile - Type I, Brown 12"x12" Vinyl Floor Tile - Type II, etc.). This procedure minimizes the potential of incorrect conclusions based exclusively upon the appearance of the material or the construction period during which it was installed.

Each sample was placed in an individual sample bag, sealed and labeled with a unique sample identification number. Sample locations are depicted in scale drawings of the buildings in Appendix A through Appendix F. All samples were submitted to NVL Laboratories, Inc. of Seattle, Washington, for analysis to determine asbestos content. NVL Laboratories, Inc. participates in the National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP) mandated by EPA under the AHERA regulations. A copy of the laboratory certification is provided in Appendix H.

The samples were analyzed according to EPA methods described in EPA 660/R-93/116 utilizing Polarized Light Microscopy (PLM). Using the PLM method, the analyst is able to determine the type and concentration of asbestos in each sample. The concentration is provided as a percentage of the total area (total area is determined by the field of view while observed through the microscope) of the sample material. The limit of detection for this particular method is less than one percent (>1%). As with most analyzing techniques there is a variance associated with PLM analysis and for this reason the results are presented as a reliable range. Where results are reported as "<1%" or "Trace", this indicates that at least one asbestos fiber was detected. Where results are reported as "No Asbestos Detected" or "ND", no asbestos fibers were found.

Each layer in a sample is viewed and analyzed by NVL as a distinct material, and analysis results reported with the asbestos percentages determined by the analyst in each layer of the suspect material. The individual layer information is important in that for many cases of multi-layered samples, only a single layer of the entire sample may contain asbestos. By referencing the layer description in the Bulk Asbestos Fiber Analysis, the user can distinguish the layer(s) in which asbestos occurs.

Analysis results and the extent of materials which tested >1% asbestos content is shown in each applicable appendice.

IV. SURVEY FINDINGS

The result of EKNA's ACBM surveys and TCLP testing per building are provided in the appendices (see "Table of Contents" for listing). Each Appendice consist of the following (if applicable).

Introduction -Identifying the Building name and /or designated number.
 -Brief description of the surveyed building.

TCLP Test Results

Summary of Identified ACBM

Remarks and Comments

Survey Findings -EKNA's asbestos inspector(s) name(s).
 -Total suspected asbestos samples collected.
 -Listing of all suspect materials submitted for analysis

AutoCAD Drawings -Sample locations.
 -Extent of identified ACBM

Chain of Custody Forms and Asbestos Bulk Analysis Forms

Chain of Custody Forms and TCLP Analysis Form

V. DISCUSSIONS

The National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations require that all regulated asbestos-containing building material (RACM) be removed from a facility prior to demolition or renovation activities that would break up, dislodge, or similarly disturb the materials, or preclude access to the material for subsequent removal. NESHAP regulations define RACM as: friable asbestos materials, Category I non-friable ACBM, (vinyl tile, mastics, adhesives, asphalt roofing materials, packing and gaskets) that will be or have been subject to sanding, grinding, cutting, or abrading, or Category II non-friable ACM (all remaining types of non-friable ACM not included in Category I) that have a high probability of becoming, or have become, crumbled, pulverized, or reduced to powder by hand pressure or the forces expected to act on the material in the course of demolition or renovation operations.

The EPA interpretation of the NESHAP regulations state that, in general, Category I and Category II non-friable materials will not release significant amounts of asbestos fibers during normal renovation activities. However, non-friable ACM which will be subject to sanding, grinding, abrading, drilling, cutting or chipping must be treated as if it were friable.

Under normal circumstances non-friable Category I and Category II ACMs in good condition (such as the mastics and roofing materials located in this survey), need not be removed prior to renovation or demolition activities. However, the local landfill may exercise discretion as to whether to permit disposal of non-friable Category I and II ACMs as a general construction waste. On Oahu, construction demolition waste landfills generally require the handling and disposal of non-friable Category I and II ACMs as though they were friable Category I ACMs.

If the amount of RACM present in an area to be renovated exceeds 260 linear feet, 160 square feet, or 35 cubic feet, the following general actions are required:

A Notification of Demolition and Renovation must be sent to the EPA and to the Hawaii State Department of Health, Clean Air Branch, at least ten working days prior to beginning work.

A licensed asbestos abatement contractor is required to perform the work. Workers must have received from eight to thirty two hours of training (dependent on type of work conducted), be medically examined and certified fit to wear a respirator, have been individually fitted to personally issued respirators, and operate under the supervision of a competent person as defined in 29 CFR 1910.1101.

Various engineering controls for the prevention of visible and/or airborne emissions must be implemented.

Asbestos-containing waste must be thoroughly wetted and properly sealed, labeled, transported and disposed of in a permitted landfill.

VI. RECOMMENDATIONS

Demolition of Buildings T-758, T-759, 845 and 846 will result in disturbance of asbestos-containing materials and abatement is generally required prior to demolition. Due to the quantity and extent of the ACM, a licensed abatement contractor will be required to perform this work.

We recommend that construction specifications detailing work practices, protective measures, and engineering controls to be employed in disturbance of each type of ACBM be prepared and incorporated into the construction documents. Additionally, we recommend that air monitoring at the work area perimeter ("area" air monitoring) be employed to verify the cleanliness of the contractor's work practices and engineering controls, and to ensure that asbestos fibers in

concentrations exceeding the Permissible Exposure Limit are not present at the site upon completion of the abatement contractor's work in each work area.

Abatement of friable Category I materials should be carried out in full containment, which includes protection of non-ACM surfaces by two layers of plastic sheeting, sealing of passages to areas outside the work area, negative air pressure within the work area, HEPA-filtered exhaust, and provision of a three-room decontamination facility.

Disturbance of non-friable Category I and Category II ACBM (ACBM which is not thermal system insulation or surfacing material, including vinyl floor tile mastics, sink insulation, and composition roofing), is subject to less severe restrictions during conduct of work. These materials are less likely to generate airborne asbestos fibers during abatement work.

Work practices for disturbance of non-friable materials (flooring mastic, window caulking and sink insulation) should include HEPA filtered air exhaust from the work area, use of wet methods, intact removal to the extent possible and OSHA-required monitoring of asbestos fiber concentrations in the breathing zone air of all workers. Polyethylene sheeting should be placed on walls adjacent to areas in which non-friable flooring materials will be disturbed, and workers should enter and exit through a decontamination facility.

Exterior non-friable Category I and Category II materials may be abated using wet methods, intact removal to the extent possible, and worker entry and exit through a decontamination facility. Abatement exterior workers shall wear respiratory protection and personal air monitoring of abatement workers breathing zone would be required.

VII. LIMITATIONS

This survey addressed identification of accessible asbestos and non-asbestos materials in areas within the agreed upon scope of work for this project of Buildings T-754, T-756, T-758, T-759, 845 and 846, Schofield Barracks, Island of Oahu, Hawaii and was limited to visible and accessible suspect asbestos-containing building materials (ACBMs) which may be required to be abated prior to any renovation/demolition activities. A possibility does exist that ACBM may be present in areas which were not surveyed, or inaccessible areas.

Some examples of inaccessible areas may be inaccessible tunnels containing pipe/valve insulation and asbestos materials within solid wall cavities. If suspect materials beyond those identified in this report are encountered during renovation/demolition activities, samples should be collected and submitted for analysis immediately. Materials at other locations which are the same in manufacture, texture, color, thickness, etc. as those which have been identified as ACBMs should also be assumed to be ACBMs.

This Asbestos Containing Building Material Survey Report provides information on the visible and accessible suspect asbestos containing materials sampled of Buildings T-754, T-756, T-758, T-759, 845 and 846, Schofield Barracks, Island of Oahu, Hawaii. It should not be construed as a final statement of the presence and condition of all asbestos containing materials at the subject property.

The information set forth is based solely on the agreed upon scope of services. This information is based on personal observation and the results of the asbestos-containing material survey. Edward K. Noda and Associates, Incorporated expressly disclaims any and all liability representations, expressed, or implied, contained in, or for omissions from this report, or any other written or oral communication which might be interpreted as establishing the total extent of all liability present at the subject property.

Our services have been performed with the usual thoroughness and competence of the consulting profession, in accordance with the standards of professional services at this time. No other warranty or representation, either expressed or implied, is included or intended.

EDWARD K. NODA & ASSOCIATES, INC.

APPENDIX A
BUILDING T-754

I Introduction

Building T-754 is a slab on grade structure comprised of wood and steel beams with painted metal corrugated siding and roofing. The building was formerly utilized as warehouse and motor pool and currently occupied by the MOSIT Center, Unit Armorer School and Artillery Training

II TCLP Results

The TCLP result for Building T-754 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

NO ACBM IDENTIFIED

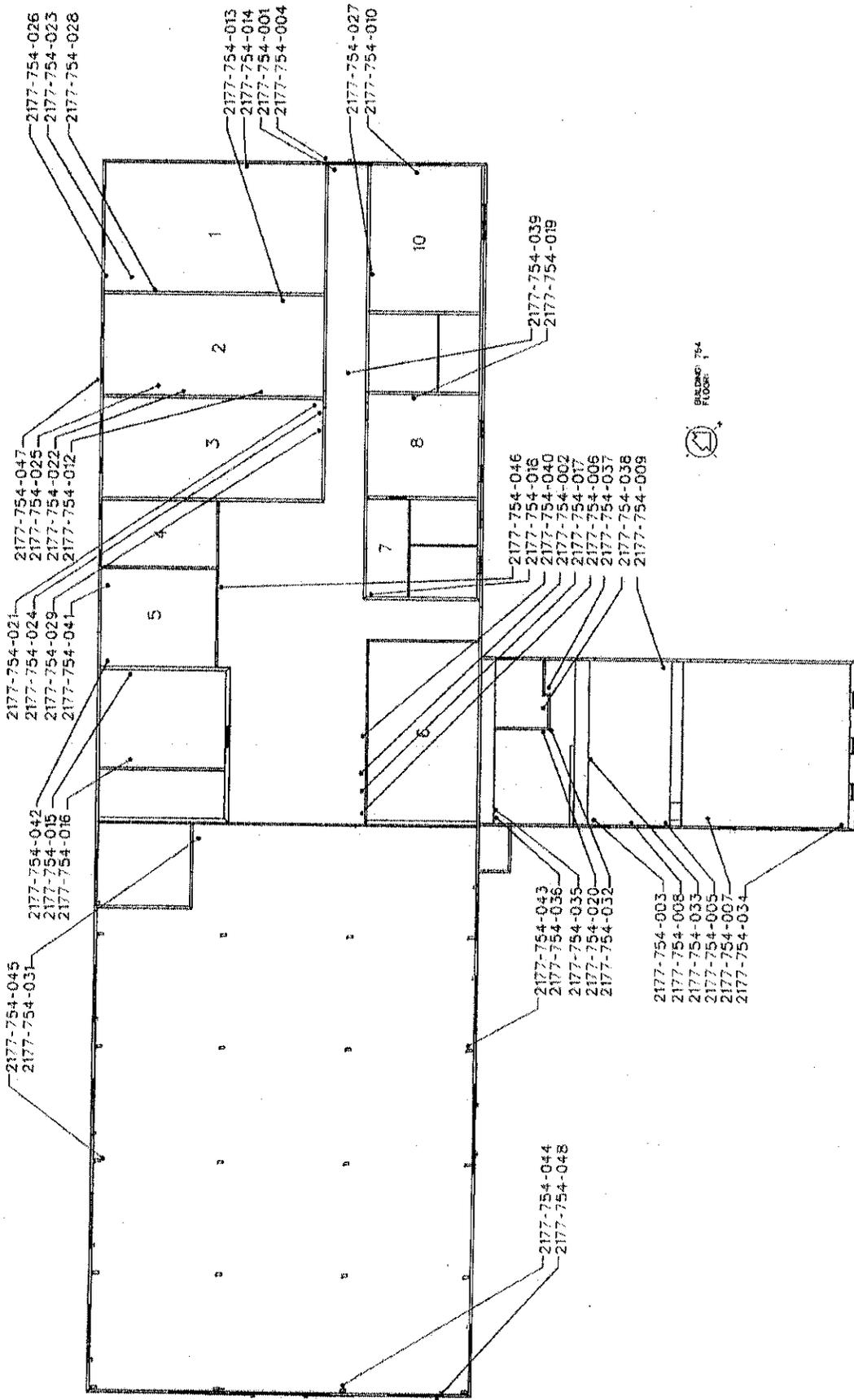
IV Remarks and Comments

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified seventeen (17) distinct material types and submitted forty eight (48) suspect samples for laboratory analysis. Material types sampled are listed below.

- 12" x 12" Beige Vinyl Floor Tile with Mastic
- 12" x 12" Red Vinyl Floor Tile with Mastic
- Blue Sheet Vinyl with Adhesive
- Floor Leveling Compound - Pink
- Floor Leveling Compound - White
- 4" Light Brown Cove Base with Adhesive
- 4" Black Cove Base with Adhesive
- 4" Gray Cove Base with Adhesive
- 2' x 4' Ceiling Tile - Fissure - Type 2
- 2' x 4' Ceiling Tile - Pinholes
- 2' x 4' Ceiling Tile
- Canec Wall/Ceiling panel
- Gypsum Board with Joint Compound - Type I - White
- Gypsum Board with Joint Compound - Type II - White
- Gypsum Board with Joint Compound - Brown
- Silver Paint on Structural Steel
- Window Caulking



2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA83-00-D-0007, T.O. 0003

Sample Location Plan
Building 754

FIGURE
A-2

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083469 Client Sample #: 2177-754-01

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083470 Client Sample #: 2177-754-02

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083471 Client Sample #: 2177-754-03

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
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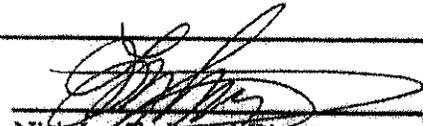
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Tel: 206.547.0100
Fax: 206.634.1936

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10434.00

Client Project #: 2177-00F

Number of samples: 48

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083472 Client Sample #: 2177-754-04

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Brown flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20083473 Client Sample #: 2177-754-05

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Brown flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

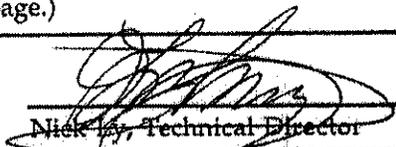
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083474 Client Sample #: 2177-754-06

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083475 Client Sample #: 2177-754-07

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20083476 Client Sample #: 2177-754-08

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

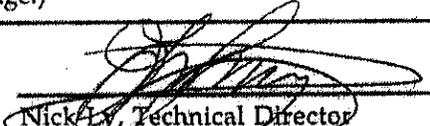
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00

Client Project #: 2177-00F

Number of samples: 48

Lab ID #: 20083477 Client Sample #: 2177-754-09

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 3%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083478 Client Sample #: 2177-754-10

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 3%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083479 Client Sample #: 2177-754-11

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 3%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

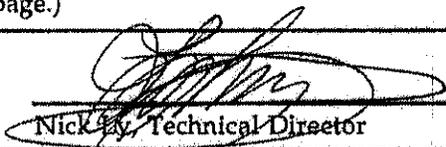
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

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#102063

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

Lab ID #: 20083480 Client Sample #: 2177-754-12

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20083481 Client Sample #: 2177-754-13

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20083482 Client Sample #: 2177-754-14

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

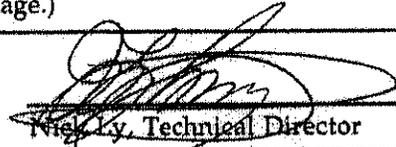
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000



Nick Ly, Technical Director

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

Lab ID #: 20083483 Client Sample #: 2177-754-15

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material with coating and paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

NON-FIBROUS MATERIALS:
Binder & filler, Paint

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083484 Client Sample #: 2177-754-16

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material with coating and paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

NON-FIBROUS MATERIALS:
Binder & filler, Paint

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083485 Client Sample #: 2177-754-17

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material with coating and paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

NON-FIBROUS MATERIALS:
Binder & filler, Paint

ASBESTOS TYPE:
*None Detected

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10434.00

Client Project #: 2177-00F

Number of samples: 48

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083486 Client Sample #: 2177-754-18

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black flat rubbery material, LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
LAYER 2: Cellulose 15%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083487 Client Sample #: 2177-754-19

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black flat rubbery material, LAYER 2: White mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
LAYER 2: Cellulose 15%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083488 Client Sample #: 2177-754-20

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black flat rubbery material, LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

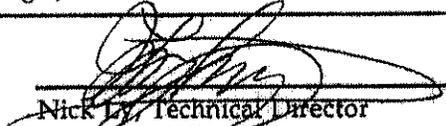
LAYER 1: Cellulose 1%
LAYER 2: Cellulose 15%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client		
Analyzed by: Wei Long Tai	Date: 08/18/2000	 Nick Ly, Technical Director
Reviewed by: Nick Ly	Date: 08/18/2000	

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Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083489 Client Sample #: 2177-754-21

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Red vinyl tile, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083490 Client Sample #: 2177-754-22

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Red vinyl tile, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

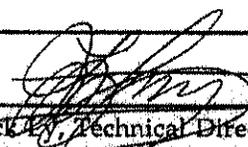
LAYER 1: Vinyl/binder, Granules
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

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Bulk Asbestos Fiber AnalysisNVLAP
#102063Client: Edward K. Noda & Associates
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NVL Batch Number: 00-10434.00

Client Project #: 2177-00F

Number of samples: 48

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083491 Client Sample #: 2177-754-23

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Red vinyl tile, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 1%
LAYER 2: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Granules
LAYER 2: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083492 Client Sample #: 2177-754-24

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Gray flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083493 Client Sample #: 2177-754-25

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Gray flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder**ASBESTOS TYPE:****PERCENT**

(Sample results are continued on the next page.)

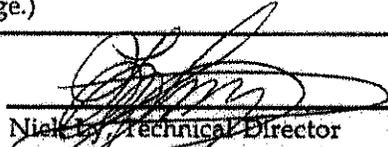
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

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Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083494 Client Sample #: 2177-754-26
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Gray flat rubbery material, LAYER 2: White mastic

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083495 Client Sample #: 2177-754-27
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 4%
LAYER 2: Cellulose 30%, Glass fibers 5%

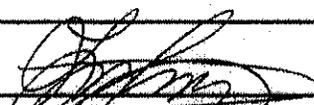
NON-FIBROUS MATERIALS:
LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083496 Client Sample #: 2177-754-28

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083497 Client Sample #: 2177-754-29

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083498 Client Sample #: 2177-754-30

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

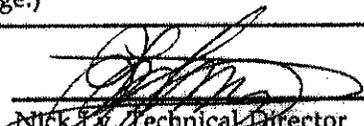
ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

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Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083499 Client Sample #: 2177-754-31

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083500 Client Sample #: 2177-754-32

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083501 Client Sample #: 2177-754-33

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083502 Client Sample #: 2177-754-34

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20083503 Client Sample #: 2177-754-35

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

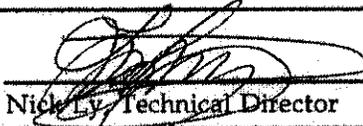
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083504 Client Sample #: 2177-754-36

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White powdery material with white paint, LAYER 2: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 30%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20083505 Client Sample #: 2177-754-37

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Blue sheet vinyl, LAYER 2: Gray fibrous material with yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 65%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder

LAYER 2: Binder & filler, Mastic/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

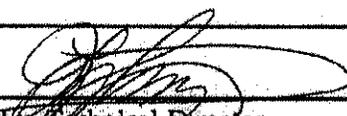
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083506 Client Sample #: 2177-754-38

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Blue sheet vinyl, LAYER 2: Gray fibrous material with yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 65%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Binder & filler, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083507 Client Sample #: 2177-754-39

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Pink chalky material

OTHER FIBROUS MATERIALS:

Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20083508 Client Sample #: 2177-754-40

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: White chalky material

OTHER FIBROUS MATERIALS:

Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00

 Client Project #: 2177-00F
 Number of samples: 48

Lab ID #: 20083509 Client Sample #: 2177-754-41

 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:
 Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler
PERCENT
 ND

Lab ID #: 20083510 Client Sample #: 2177-754-42

 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:
 Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler
PERCENT
 ND

Lab ID #: 20083511 Client Sample #: 2177-754-43

 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Black asphaltic material with coating and paint

OTHER FIBROUS MATERIALS:
 Cellulose 3%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler, Paint
PERCENT
 ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/115 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP

#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00

Client Project #: 2177-00F

Number of samples: 48

Lab ID #: 20083512 Client Sample #: 2177-754-44

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 20083513 Client Sample #: 2177-754-45

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 20083514 Client Sample #: 2177-754-46

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

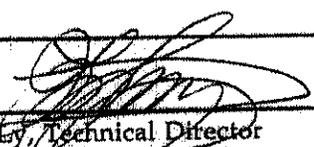
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/115 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10434.00
Client Project #: 2177-00F
Number of samples: 48

Lab ID #: 20083515 Client Sample #: 2177-754-47

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 20083516 Client Sample #: 2177-754-48

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

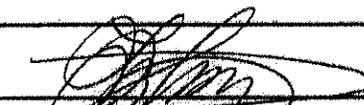
Binder & filler, Paint

PERCENT

ND

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly - Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and aculty of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

APPENDIX B

BUILDING T-756

(44) 00-10093

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/21/88
SHEET 5 OF 8
E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	2	Plenum	C2B	35	BE	HVAC Vibration Cloth
2	B	2	Plenum	C2B	35	BE	
3	B	2	Plenum	C2B	35	BE	
4	B	2	Plenum	C2C	36	BF	HVAC DUCT INSULATION
5	B	2	Plenum	C2C	36	BF	
6	B	2	Plenum	C2C	36	BF	
7	B	2	Plenum	C2C	36	BF	
8	B	2	Plenum	C2C	36	BF	
9	B	3	Plenum	C2A	34	BG	Joint Sealant/Mastic on Fiberglass Pipe Insulation
10	B	3	Plenum	C2A	34	BG	
11	B	3	Plenum	C2A	34	BG	
12	B	3	Plenum	C2A	34	BG	

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT DATE: _____
 JOB NO. 2177-00F BATCH NO. EKNAB1333 DELIVERED TO LAB BY: Fed X
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: V. HARRIS, D. TISDELL
 SIGNATURE: W.C. Harris, D. Tisdell
 TIME COMPLETED: 17:00

LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: [Signature]
 DATE: 8/21/88 TIME: 5:30am INITIALS: STP
 ANALYZED BY: [Signature]
 LAB O.C. APPROVAL: [Signature]
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

I Introduction

Building T-756 is a slab on grade construction and built of corrugated siding and roofing. The building is currently occupied by HHB DIVARTY Storage, 25th FAD, and HHB DIVARTY Fire Support Office and utilized to store and repair equipment

II TCLP Results

The TCLP result for Building T-756 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

NO ACBM IDENTIFIED

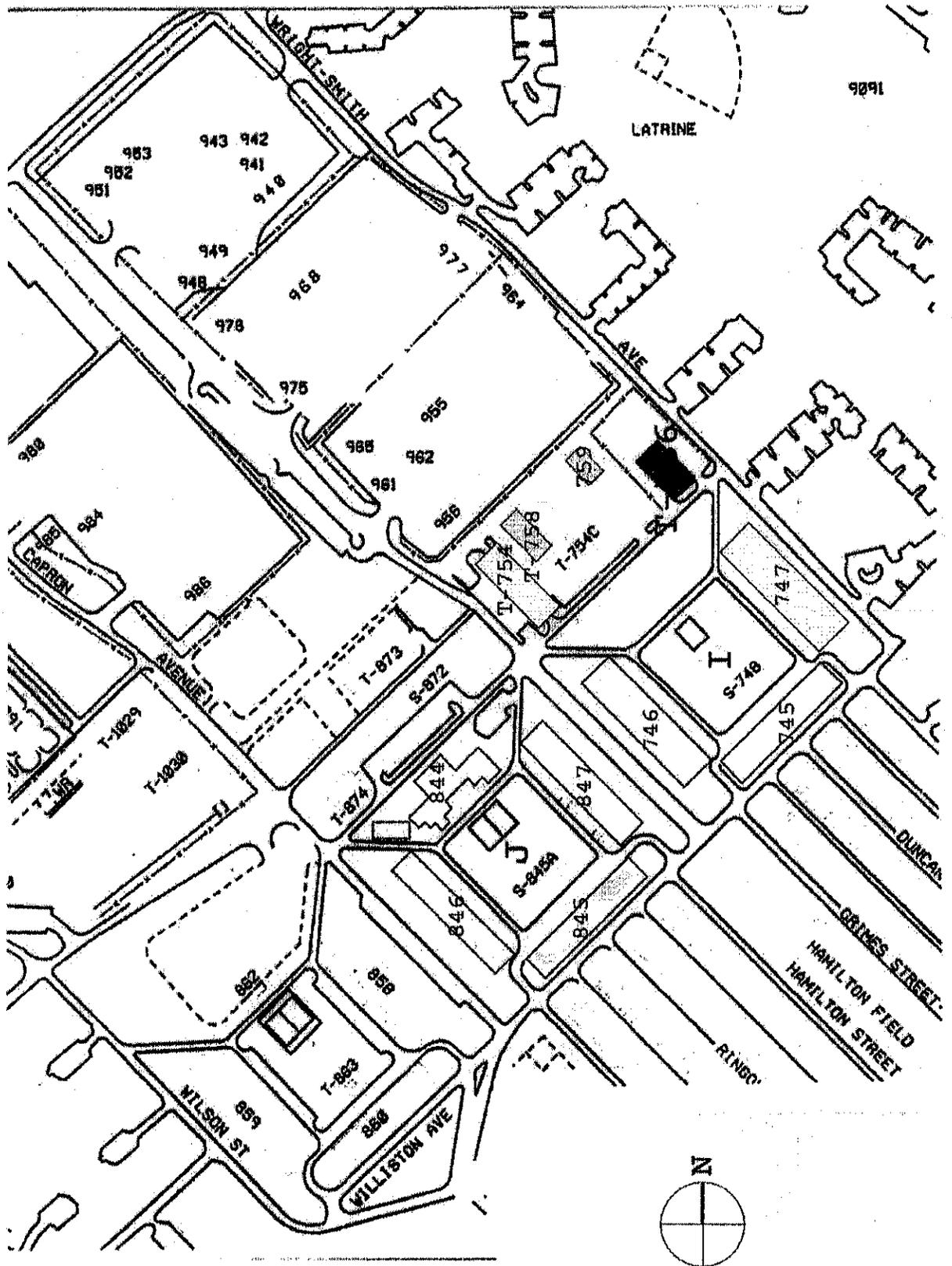
IV Remarks and Comments

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified seven (7) distinct material types and submitted sixteen (16) suspect samples for laboratory analysis. Material types sampled are listed below.

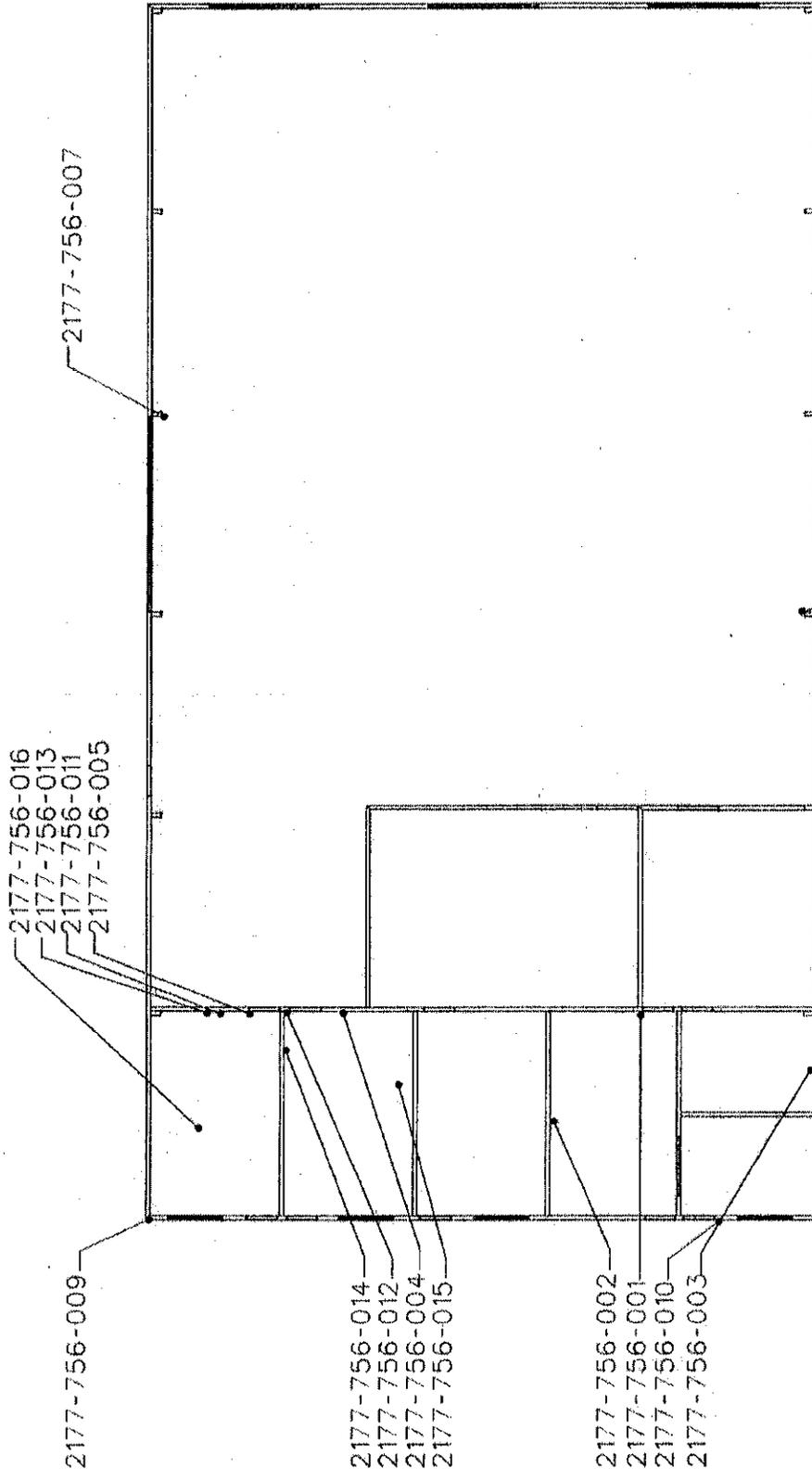
Gypsum Board with Joint Compound
Structural Member Paint
Rain Gutter Sealant
Window/Door Caulking
12" x 12" Brown Vinyl Floor Tile with Mastic
4" Brown Cove Base with Adhesive
2' x 4' Acoustical Ceiling Tile - Fissure Pattern



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schrieff Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 756

FIGURE
 B-1



BUILDING: 756
FLOOR: 1



2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA63-00-D-0007, T.O. 0003

Sample Location Plan
Building 756

FIGURE
B-2

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: 0010462

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

SAMPLE I.D. NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION	
1	B	1	OFFICE	WBI	1	A	Gypsum Board with Joint Compound	↓
2	B	1	OFFICE	WAI	1	A		↓
3	B	1	STORAGE ROOM	WCI	1	A		↓
4	B	1	STORAGE ROOM	WBI	1	A		↓
5	B	1	STORAGE ROOM	WBI	1	A		↓
6	B	1	SHOP AREA	WBI	2	B	Structural Member Paint	↓
7	B	1	SHOP AREA	WCI	2	B		↓
8	B	1	Exterior	WCI	3	C	Rain Gutter Sealant	↓
9	B	1	Exterior	WDI	3	C		↓
10	B	1	Exterior	WDI	4	D	Window/Door Caulking	↓
11	B	1	Storage Rm	FIA	5	E	12" x 12" Brown Vinyl Floor Tile with Mastic	↓
12	B	1	Storage Rm	FIA	5	E		↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
200763624							
76035							
76076							
76077							
76078							
4639							
76079							
76080							
76081							
76082							
76083							
76084							
76085							

RECEIVED
 8/11/00

REQUESTED COMPLETION DATE: 5 Day TAT DATE: 08/07/00
 JOB NO. 2177-08 BATCH NO. EKNAB131
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLES NAME: W. HARRIS, D. TISDELL
 SIGNATURE: [Signature]
 TIME COMPLETED: 14:30 DELIVERED TO LAB BY: FedEx
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4788 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: [Signature]
 DATE: 8/11/00 TIME: 8:30am INITIALS: TL
 ANALYZED BY: SP
 LAB Q.C. APPROVAL: AL
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: 00-10462

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 08/09/00
SHEET 2 OF 2

EMAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-756-13	B	1	Storage Rm	F1A	G	F	4" Brown Cove Base with Adhesive ↓
2 2177-756-14	B	1	Storage Rm	F1A	G	F	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
3 2177-756-15	B	1	Storage Rm	C1A	7	G	2'x4' Acoustical Ceiling Tile - Fissure Pattern ↓
4 2177-756-16	B	1	Storage Rm	C1A	7	G	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
5 2177-756-	B						
6 2177-756-	B						
7 2177-756-	B						
8 2177-756-	B						
9 2177-756-	B						
10 2177-756-	B						
11 2177-756-	B						
12 2177-756-	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 2177-756-16					
2 3047					
3 3048					
4 3049					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT DATE: 08/09/00

JOB NO. 2177-08F BATCH NO. ENX40333

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TSOBELL

SIGNATURE: W. Harris DELIVERED TO LAB BY: Fuller

TIME COMPLETED: 14:30

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: Sharon Stark

DATE: 8/11/00 TIME: 8:30 am INITIALS: TS

ANALYZED BY: SP

LAB Q.C. APPROVAL: AK

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piliikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10462.00
Client Project #: 2177-00F
Number of samples: 16

Lab ID #: 20083634 Client Sample #: 3177-756-01

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20083635 Client Sample #: 3177-756-02

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

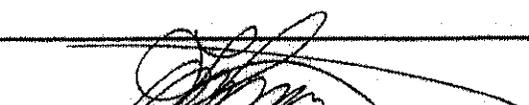
NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10462.00

Client Project #: 2177-00F

Number of samples: 16

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083636 Client Sample #: 3177-756-03

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20083637 Client Sample #: 3177-756-04

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

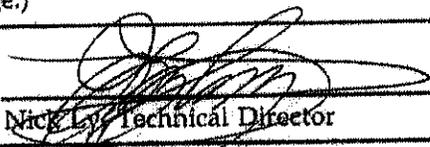
LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10462.00
Client Project #: 2177-00F
Number of samples: 16

Lab ID #: 20083638 Client Sample #: 3177-756-05

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Beige paint LAYER 2: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083639 Client Sample #: 3177-756-06

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Mixture of silver paint, black asphaltic mastic and tan paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Paint, Asphalt/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20083640 Client Sample #: 3177-756-07

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Mixture of silver paint, black asphaltic mastic and green paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

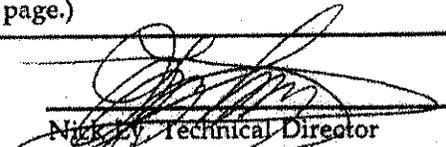
Paint, Asphalt/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10462.00
Client Project #: 2177-00F
Number of samples: 16

Lab ID #: 20083641 Client Sample #: 3177-756-08

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: White fine grained calcareous matrix with surface paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint

PERCENT

ND

Lab ID #: 20083642 Client Sample #: 3177-756-09

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: White fine grained calcareous matrix with surface paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint

PERCENT

ND

Lab ID #: 20083643 Client Sample #: 3177-756-10

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: White soft calcareous matrix with surface paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint

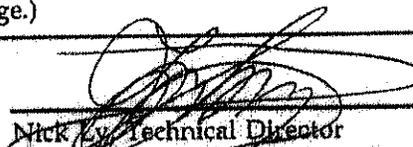
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and aculty of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10462.00
Client Project #: 2177-00F
Number of samples: 16

Lab ID #: 20083644 Client Sample #: 3177-756-11

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Brown brittle mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083645 Client Sample #: 3177-756-12

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Brown brittle mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083646 Client Sample #: 3177-756-13

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

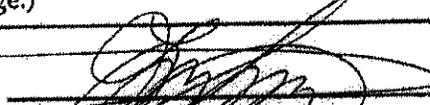
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All Bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10462.00

Client Project #: 2177-00F

Number of samples: 16

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083647 Client Sample #: 3177-756-14

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083648 Client Sample #: 3177-756-15

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material with surface paint

OTHER FIBROUS MATERIALS:

Cellulose 55%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite, Paint

ASBESTOS TYPE: PERCENT
*None Detected ND

Lab ID #: 20083649 Client Sample #: 3177-756-16

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material with surface paint

OTHER FIBROUS MATERIALS:

Cellulose 55%

NON-FIBROUS MATERIALS:

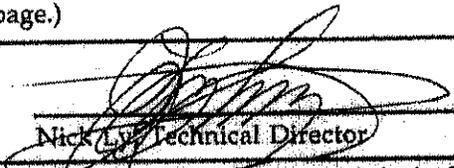
Calcareous matrix, Perlite, Paint

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10462.00
Client Project #: 2177-00F
Number of samples: 16

*None Detected

ND

Sampled by: Client

Analyzed by: Steve Zhang

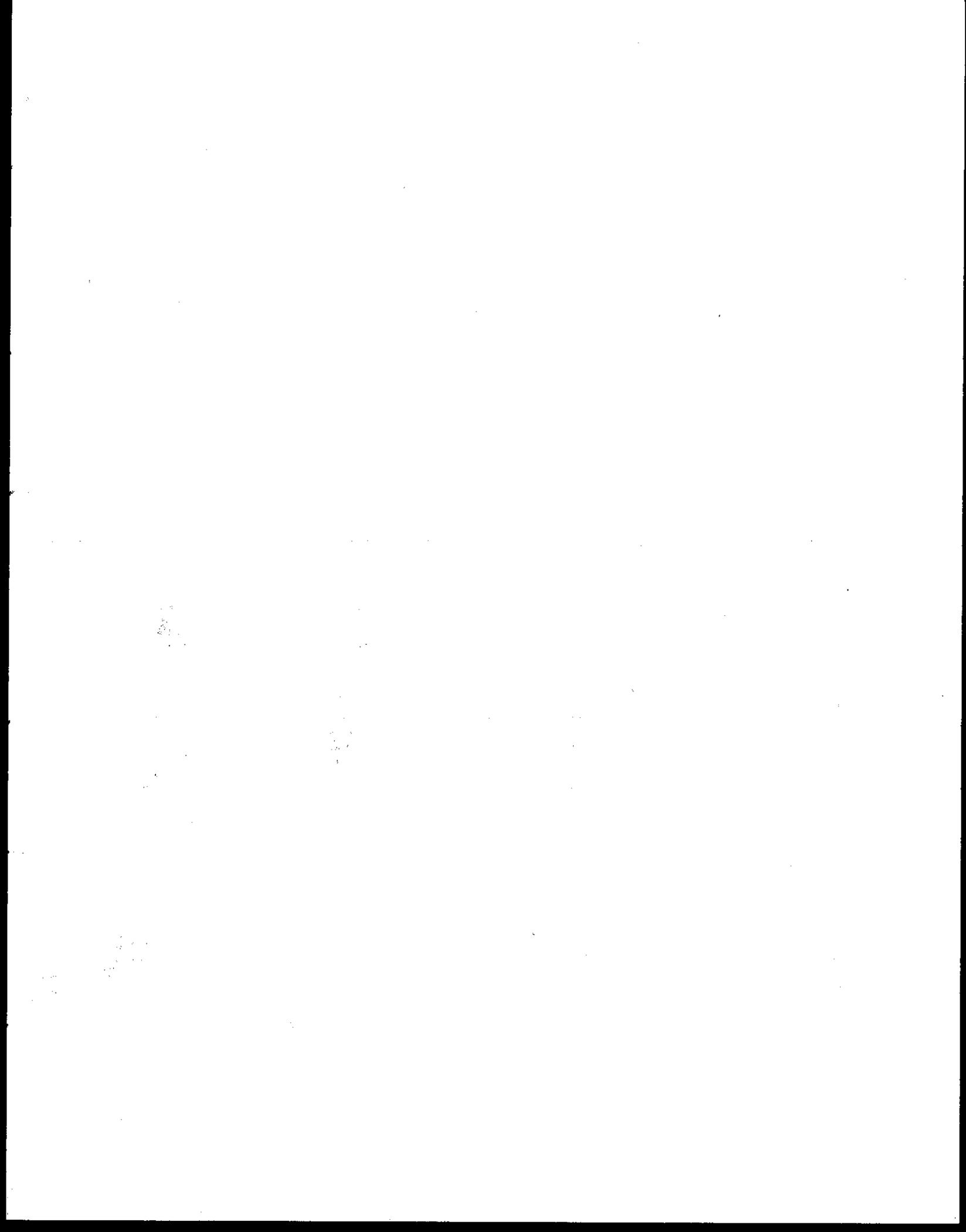
Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



APPENDIX C
BUILDING T-758

I Introduction

Building T-758 is a slab on grade construction and built of prefabricated metal, utilized as motor pool training center.

II TCLP Results

The TCLP result for Building T-758 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

Materials found to contain greater than one percent (>1%) asbestos by laboratory analysis is listed below. An asterisk preceding the material description indicates the material is considered friable or potentially friable.

Drain Pipe Sealant - Black Asphaltic Soft Material
***Roof Sealant - Black Asphaltic Material with Gray Surface**

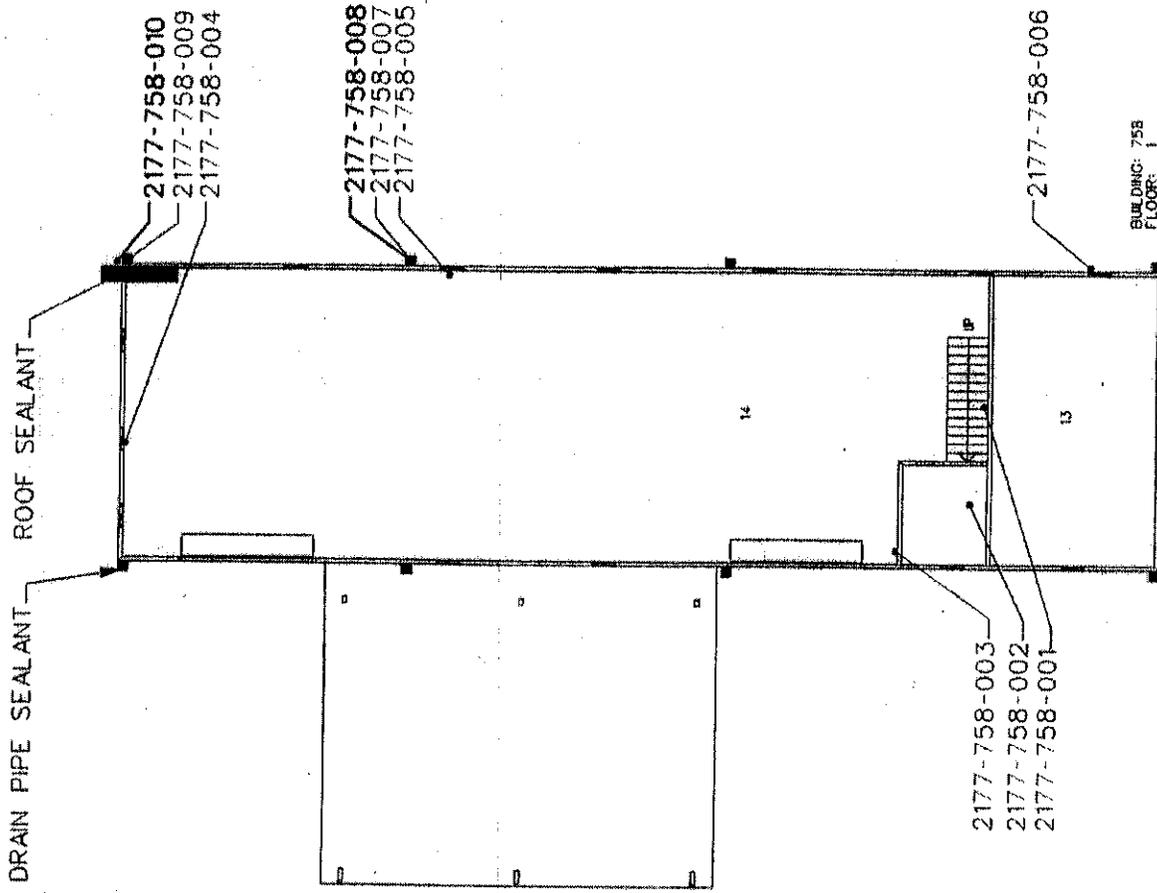
IV Remarks and Comments

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified five (5) distinct material types and submitted ten (10) suspect samples for laboratory analysis. Material types sampled are listed below. Materials found to contain >1% asbestos are indicated in bold print (an asterisk indicates a friable or potentially friable material).

Gypsum Board with Joint Compound
Window Caulking
Corrugated Roofing Sealant
Drain Pipe Sealant - Black Asphaltic Soft Material
***Roof Sealant - Black Asphaltic Material with Gray Surface**



BUILDING: 758
FLOOR: 1

- DRAIN PIPE SEALANT
- ROOF SEALANT

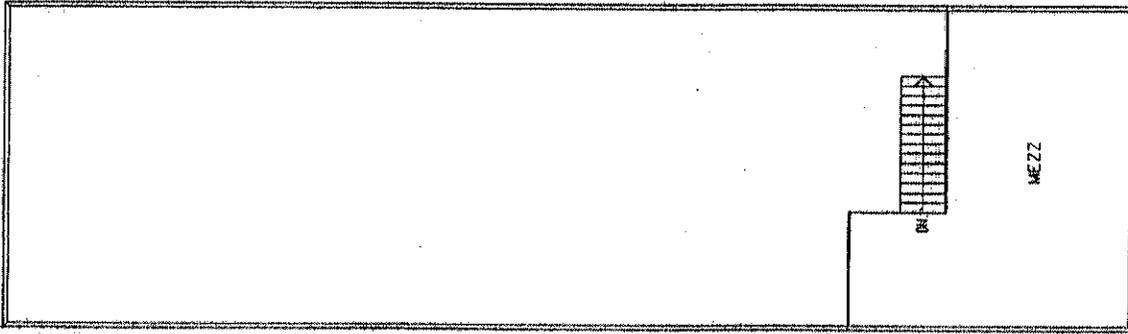
2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
 2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DAC833-00-D-9007, T.O. 0003

Sample Location Plan
 Building 758

FIGURE
C-2



BUILDING: 758
FLOOR: 2



2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schrofield Barracks, Island of Oahu, Hawaii
DACAB3-00-D-0007, T.O. 0903

FIGURE
C-3

Sample Location Plan
Building 758

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, SchofieldNVL Batch Number: 00-10463.00
Client Project #: 2177-00F
Number of samples: 10

Lab ID #: 20083650 Client Sample #: 2177-758-01

Sample Location: Quad I & J, Schofield

Description: LAYER 1: Off-white compacted powdery material with light green paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 15%, Glass fibers 2%**NON-FIBROUS MATERIALS:**LAYER 1: Mineral/binder, Paint
LAYER 2: Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083651 Client Sample #: 2177-758-02

Sample Location: Quad I & J, Schofield

Description: LAYER 1: Off-white compacted powdery material with white paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 15%, Glass fibers 2%**NON-FIBROUS MATERIALS:**LAYER 1: Mineral/binder, Paint
LAYER 2: Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083652 Client Sample #: 2177-758-03

Sample Location: Quad I & J, Schofield

Description: LAYER 1: Off-white compacted powdery material with light green paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 15%, Glass fibers 2%**NON-FIBROUS MATERIALS:**LAYER 1: Mineral/binder, Paint
LAYER 2: Gypsum/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf KhanDate: 08/18/2000
Date: 08/18/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, Schofield

NVL Batch Number: 00-10463.00
Client Project #: 2177-00F
Number of samples: 10

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20083653 Client Sample #: 2177-758-04

Sample Location: Quad I & J, Schofield
Description: Cream brittle molded material

OTHER FIBROUS MATERIALS:

Cellulose 1%

NON-FIBROUS MATERIALS:

Putty compound, Mineral grains

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083654 Client Sample #: 2177-758-05

Sample Location: Quad I & J, Schofield
Description: LAYER 1: Cream brittle molded material, LAYER 2: White soft molded material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
LAYER 2: Cellulose 1%

NON-FIBROUS MATERIALS:

LAYER 1: Putty compound, Mineral grains
LAYER 2: Putty compound, Mineral grains

ASBESTOS TYPE:

LAYER 1: *None Detected
LAYER 2: *None Detected

PERCENT

ND
ND

Lab ID #: 20083655 Client Sample #: 2177-758-06

Sample Location: Quad I & J, Schofield
Description: Gray brittle molded material

OTHER FIBROUS MATERIALS:

Cellulose 1%

NON-FIBROUS MATERIALS:

Putty compound, Mineral grains

ASBESTOS TYPE:

PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf Khan

Date: 08/18/2000
Date: 08/18/2000


Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, SchofieldNVL Batch Number: 00-10463.00
Client Project #: 2177-00F
Number of samples: 10***None Detected****ND**

Lab ID #: 20083656 Client Sample #: 2177-758-07

Sample Location: Quad I & J, Schofield
Description: Gray soft material**OTHER FIBROUS MATERIALS:**

*None Detected

NON-FIBROUS MATERIALS:

Sealant compound, Mineral grains

ASBESTOS TYPE:

*None Detected

PERCENT**ND**

Lab ID #: 20083657 Client Sample #: 2177-758-08

Sample Location: Quad I & J, Schofield

Description: LAYER 1: Gray rubbery soft material, LAYER 2: Black asphaltic soft material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Sealant compound
LAYER 2: Asphalt/binder, Mineral grains**ASBESTOS TYPE:**

LAYER 1: *None Detected

LAYER 2: Chrysotile

PERCENT**ND****2%**

Lab ID #: 20083658 Client Sample #: 2177-758-09

Sample Location: Quad I & J, Schofield

Description: Gray rubbery soft material

OTHER FIBROUS MATERIALS:

*None Detected

NON-FIBROUS MATERIALS:

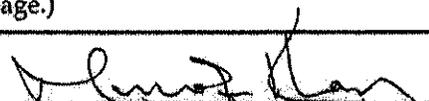
Sealant compound

ASBESTOS TYPE:

*None Detected

PERCENT**ND**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf KhanDate: 08/18/2000
Date: 08/18/2000
Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
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Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, Schofield

NVL Batch Number: 00-10463.00
Client Project #: 2177-00F
Number of samples: 10

Lab ID #: 20083659 Client Sample #: 2177-758-10

Sample Location: Quad I & J, Schofield
Description: Black asphaltic material with gray surface

OTHER FIBROUS MATERIALS:
Cellulose 1%

NON-FIBROUS MATERIALS:
Asphalt/binder, Mineral grains
PERCENT
5%

ASBESTOS TYPE:
Chrysotile

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf Khan

Date: 08/18/2000
Date: 08/18/2000


Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Summary Report
Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, Schofield

NVL Batch Number: 00-10463.00
Client Project #: 2177-00F
Number of samples: 10

Lab #: 20083650 Client's #: 2177-758-01
Sample description:
LAYER 1: Off-white compacted powdery material with light green paint, LAYER 2: White chalky material with paper

ASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab #: 20083653 Client's #: 2177-758-04
Sample description:
Cream brittle molded material

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #: 20083651 Client's #: 2177-758-02
Sample description:
LAYER 1: Off-white compacted powdery material with white paint, LAYER 2: White chalky material with paper

ASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab #: 20083654 Client's #: 2177-758-05
Sample description:
LAYER 1: Cream brittle molded material, LAYER 2: White soft molded material

ASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab #: 20083652 Client's #: 2177-758-03
Sample description:
LAYER 1: Off-white compacted powdery material with light green paint, LAYER 2: White chalky material with paper

ASBESTOS TYPE PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab #: 20083655 Client's #: 2177-758-06
Sample description:
Gray brittle molded material

ASBESTOS TYPE PERCENT
*None Detected ND

Lab #: 20083656 Client's #: 2177-758-07
Sample description:
Gray soft material

ASBESTOS TYPE PERCENT
*None Detected ND

DRAFT

APPENDIX D
BUILDING T-759

I Introduction

Building T-759 is an open front, motor pool building, slab on grade construction and built of prefabricated metal.

II TCLP Results

The TCLP result for Building T-759 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

Materials found to contain greater than one percent (>1%) asbestos by laboratory analysis is listed below. An asterisk preceding the material description indicates the material is considered friable or potentially friable.

***Window Caulking - Off-White Brittle Molded Material with Cream Paint**

IV Remarks and Comments

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified three (3) distinct material types and submitted five (5) suspect samples for laboratory analysis. Material types sampled are listed below. Materials found to contain >1% asbestos are indicated in **bold print** (an asterisk indicates a friable material).

Non-Conductive Paper (Breaker Box)

Non-Skid Walkway Material

***Window Caulking - Off-White Brittle Molded Material with Cream Paint**

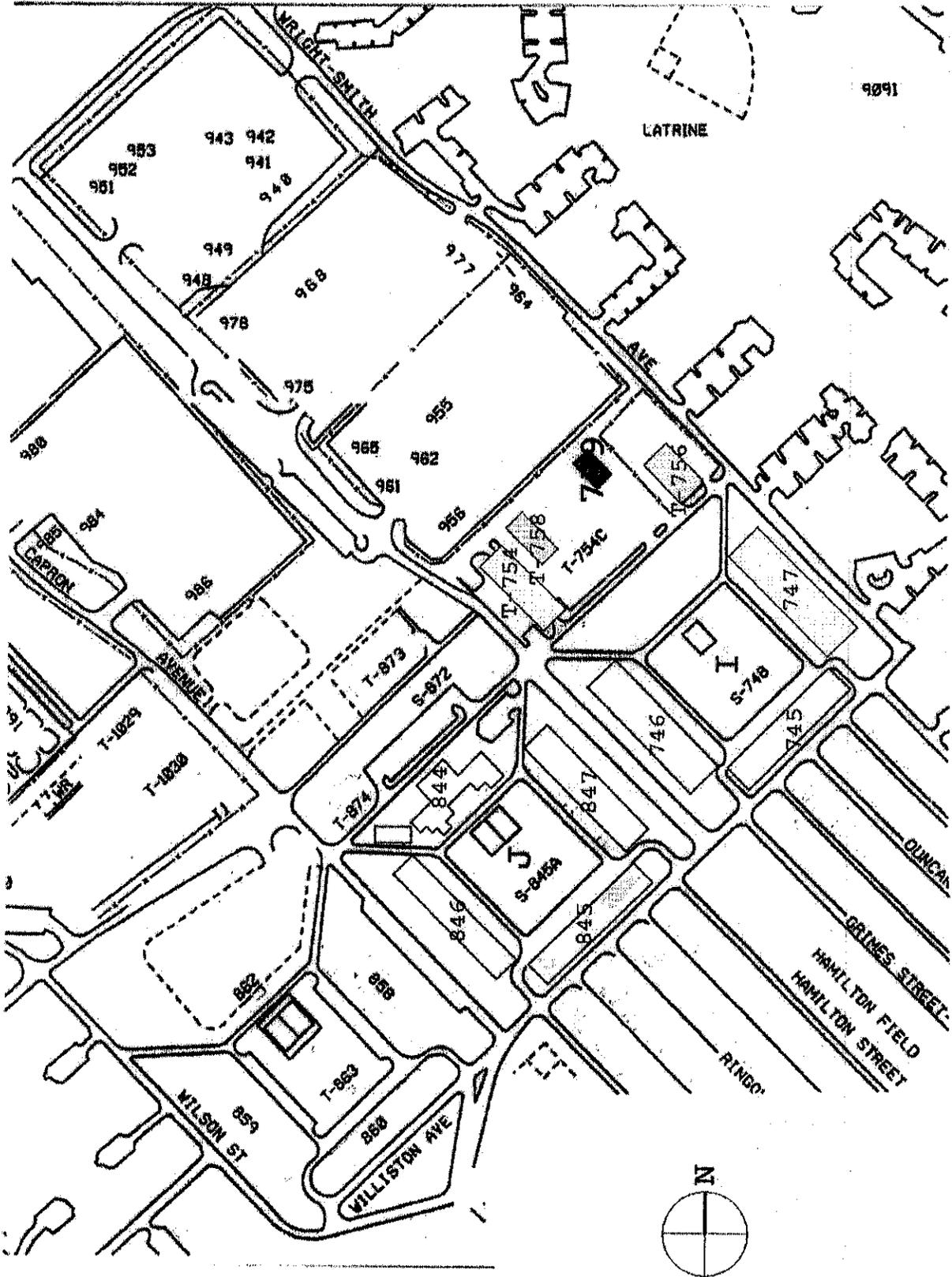
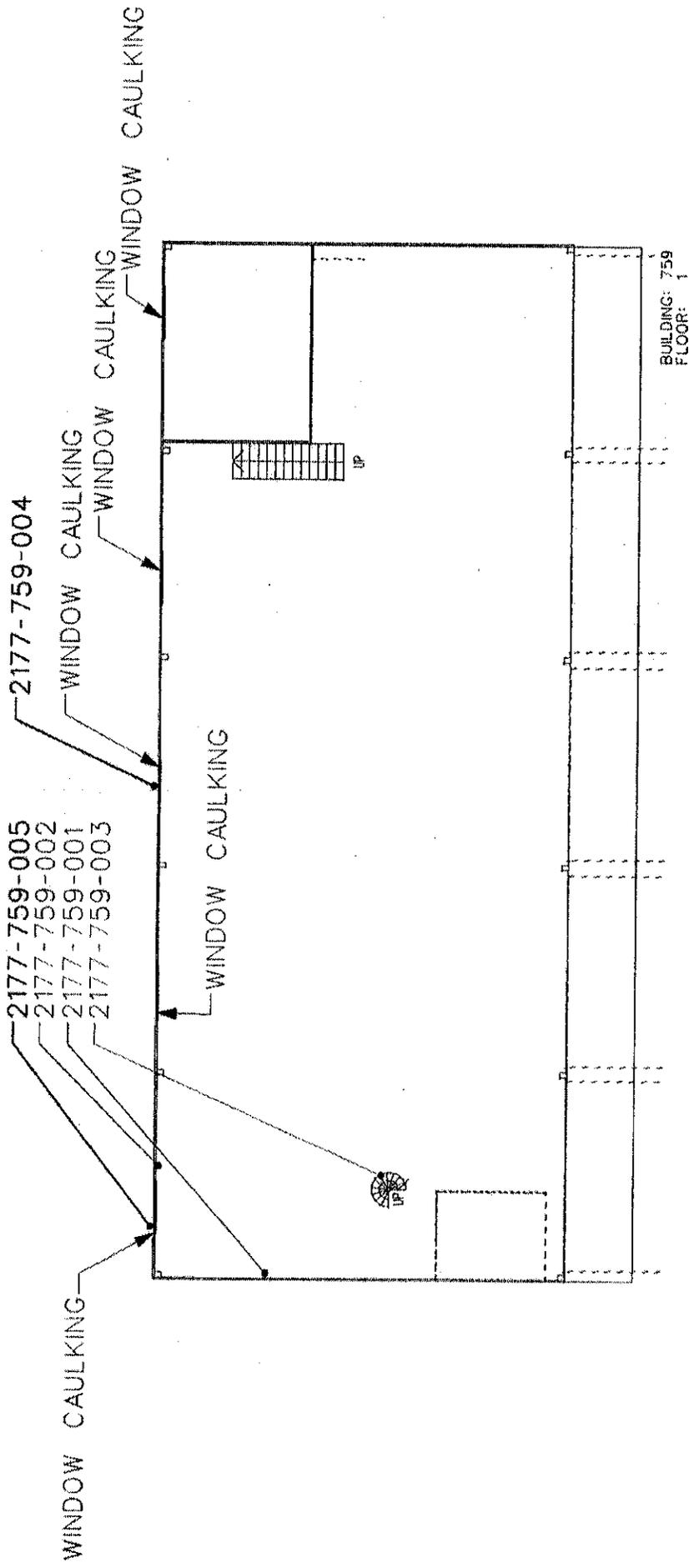


FIGURE D-1

Sample Location Plan
Building 759

The Demolition Survey for Buildings 747, T-754, T-758, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA83-00-D-0007, T.O. 0003



0 5 15 25 FT

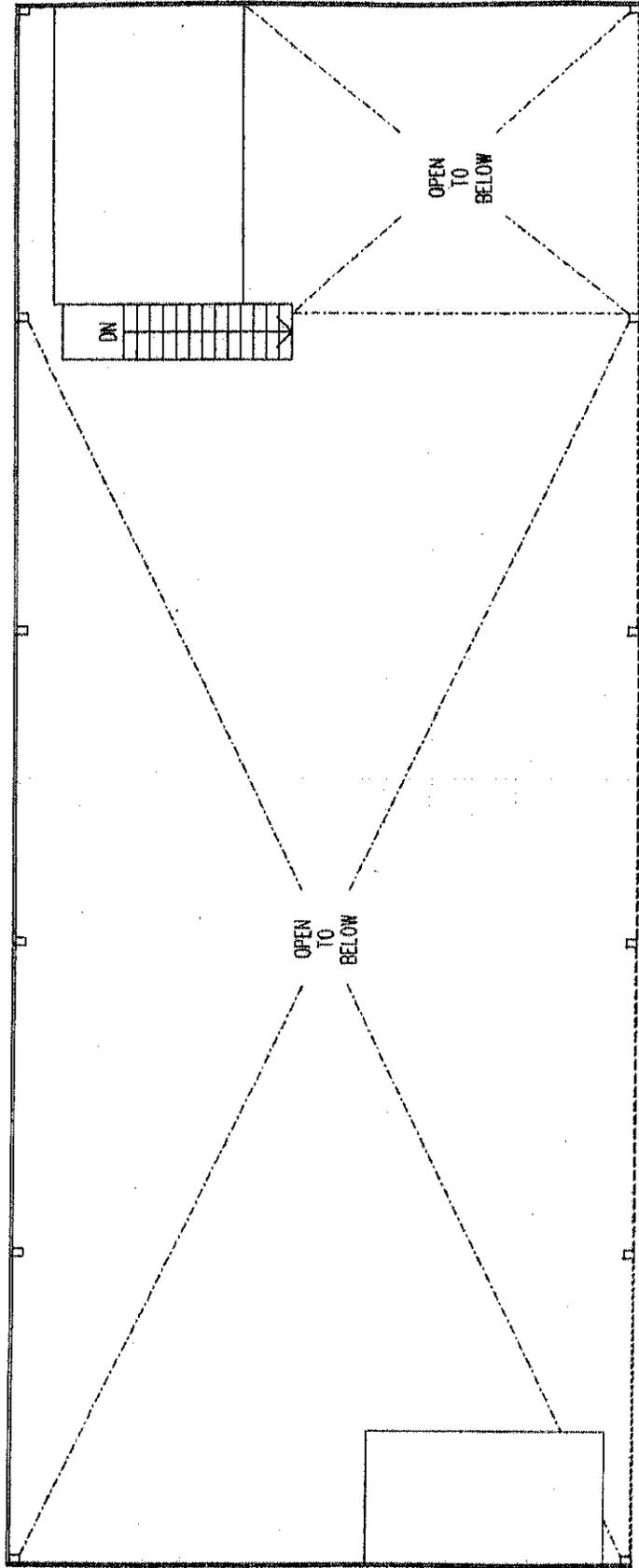
2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
 2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

BUILDING: 759
 FLOOR: 1

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-09-D-0007, T.O. 0003

Sample Location Plan
 Building 759

FIGURE
 D-2



BUILDING: 759
FLOOR: 2

2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

00-1046A

DATE: 8/18/00
SHEET: 1 OF 1

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY: QUAD I and J. SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-759-01	B	1	001	WD1	1	A	Max-Conductive Paper (Breaker Boxes)
2 2177-759-02	B	1	001	WA1	1	A	" " "
3 2177-759-03	B	1	Room 3 Steamway	F1A	2	B	Non-Skid Walkway Material
4 2177-759-04	B	1	A wall	WA3	3	C	Window Caulking
5 2177-759-05	B	1	A wall	WA3	3	C	" "
6 2177-759-	B						
7 2177-759-	B						
8 2177-759-	B						
9 2177-759-	B						
10 2177-759-	B						
11 2177-759-	B						
12 2177-759-	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CR	AM	CR	AN	
2070360					Non-Detected
2661					
2662					
3663					
3664					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day JAT

JOB NO. 2177-00F BATCH NO. EKNAB133 DATE 03/09/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: [Signature]

TIME COMPLETED: 16:30 DELIVERED TO LAB BY: Fid Ex

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4706 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: [Signature]

DATE: 08-11-00 TIME: 9:30am INITIALS: JP

ANALYZED BY: [Signature] Edward K. Noda 9:55 PM

LAB Q.C. APPROVAL: _____

PROJECT MANAGERS APPROVAL: _____

FAKED
F105

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, Schofield

NVL Batch Number: 00-10464.00
Client Project #: 2177-00F
Number of samples: 5

Lab ID #: 20083660 Client Sample #: 2177-759-01

Sample Location: Quad I & J, Schofield
Description: Gray fibrous paper

OTHER FIBROUS MATERIALS:
Cellulose 95%

NON-FIBROUS MATERIALS:
Binder/filler

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083661 Client Sample #: 2177-759-02

Sample Location: Quad I & J, Schofield
Description: Gray fibrous paper

OTHER FIBROUS MATERIALS:
Cellulose 90%, Synthetic fibers 5%

NON-FIBROUS MATERIALS:
Binder/filler

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083662 Client Sample #: 2177-759-03

Sample Location: Quad I & J, Schofield
Description: LAYER 1: Brown flat fibrous granular material, LAYER 2: Cream soft mastic

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 80%
LAYER 2: *None Detected

NON-FIBROUS MATERIALS:
LAYER 1: Binder/filler, Granules
LAYER 2: Mastic/binder

ASBESTOS TYPE:
LAYER 1: *None Detected
LAYER 2: *None Detected

PERCENT
ND
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf Khan

Date: 08/18/2000
Date: 08/18/2000


Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

Tel: 206.547.0100
Fax: 206.634.1936

4708 Aurora Ave. N., Seattle, WA 98103

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I & J, Schofield

NVL Batch Number: 00-10464.00
Client Project #: 2177-00F
Number of samples: 5

Lab ID #: 20083663 Client Sample #: 2177-759-04

Sample Location: Quad I & J, Schofield
Description: Off-white brittle molded material with cream paint

OTHER FIBROUS MATERIALS:
Cellulose 1%

ASBESTOS TYPE:
Chrysotile

NON-FIBROUS MATERIALS:
Putty compound, Mineral grains
PERCENT
2%

Lab ID #: 20083664 Client Sample #: 2177-759-05

Sample Location: Quad I & J, Schofield
Description: Off-white brittle molded material with cream paint

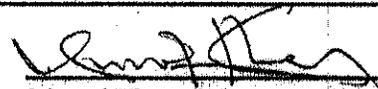
OTHER FIBROUS MATERIALS:
Cellulose 1%

ASBESTOS TYPE:
Chrysotile

NON-FIBROUS MATERIALS:
Putty compound, Mineral grains
PERCENT
2%

Sampled by: Client
Analyzed by: Barbara Gloyd
Reviewed by: Munaf Khan

Date: 08/18/2000
Date: 08/18/2000


Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

APPENDIX E

BUILDING 845

I Introduction

Buildings 845 is a 3-story concrete structure which provides office space on the first floor, and living quarters on the second and third floors. A primary hot water heater and storage tank, and a chilled water plant are located on the first floor of the building.

II TCLP Results

The TCLP result for Building 845 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

Materials found to contain greater than one percent (>1%) asbestos by laboratory analysis is listed below. An asterisk preceding the material description indicates the material is considered friable or potentially friable.

- 12" x 12" Tan with Brown Streaks Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Beige with Brown Streaks Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Beige with Grey Marbling Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Brown Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Off White Chalk Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Olive Green with Black Streaks Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Medium Brown with Streaks Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Grey/Green Marbled Vinyl Floor Tile with **Mastic - Black**
- 12" x 12" Brown with Dark Brown Spots Vinyl Floor Tile with **Mastic - Black**
- Plaster with Skim Coat - **<1% Gray Paint** (1 sample only)
- Cementitious Panels - Eaves - Grey Cementitious Asbestos Board**
- *Flashing - Main Roof at Flue/Stack - Silver Paint**
- *Joint Sealant/Mastic on Fiberglass Pipe Insulation - White Calcareous Matrix**
- *Chilled Water Supply - Hanger - White Insulation - Off White Soft Material with Paint**
- *Chilled Water Supply - Fitting - Off White Soft Material with Paint**
- *HVAC Vibration Cloth - White Woven Material - White Fibrous Material**
- *Pipe Hanger Insulation - Chilled Water - White Soft Material**
- *Hot Water Pipe Insulation - Elbow - White Coating**
- *Pipe Hanger Insulation - Chilled Water - White Soft Material**

IV Remarks and Comments

For material type "Plaster with Skim coat", sample number 2177-845-072, the initial laboratory result by PLM analysis indicated less than one percent (<1%) asbestos content. Further analysis indicate percent determined by "NESHAP Point Count Method" = 0.0% Asbestos or "Non Detected" (ND).

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

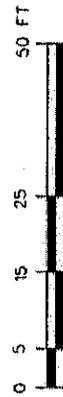
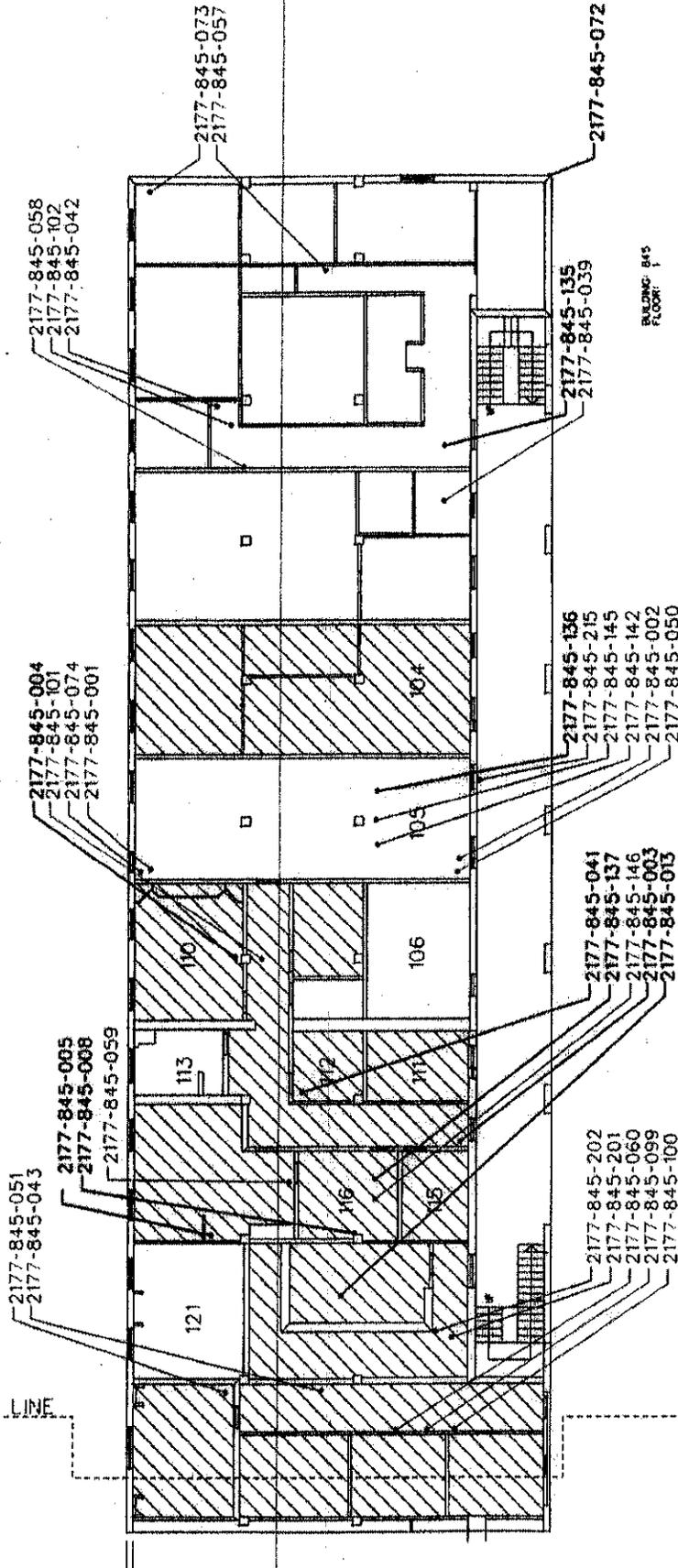
V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified fifty one (51) distinct material types and submitted two hundred seventeen (217) suspect samples for laboratory analysis. Material types sampled are listed below. Materials found to contain >1% asbestos are indicated in bold print (an asterisk indicates a friable or potentially friable material).

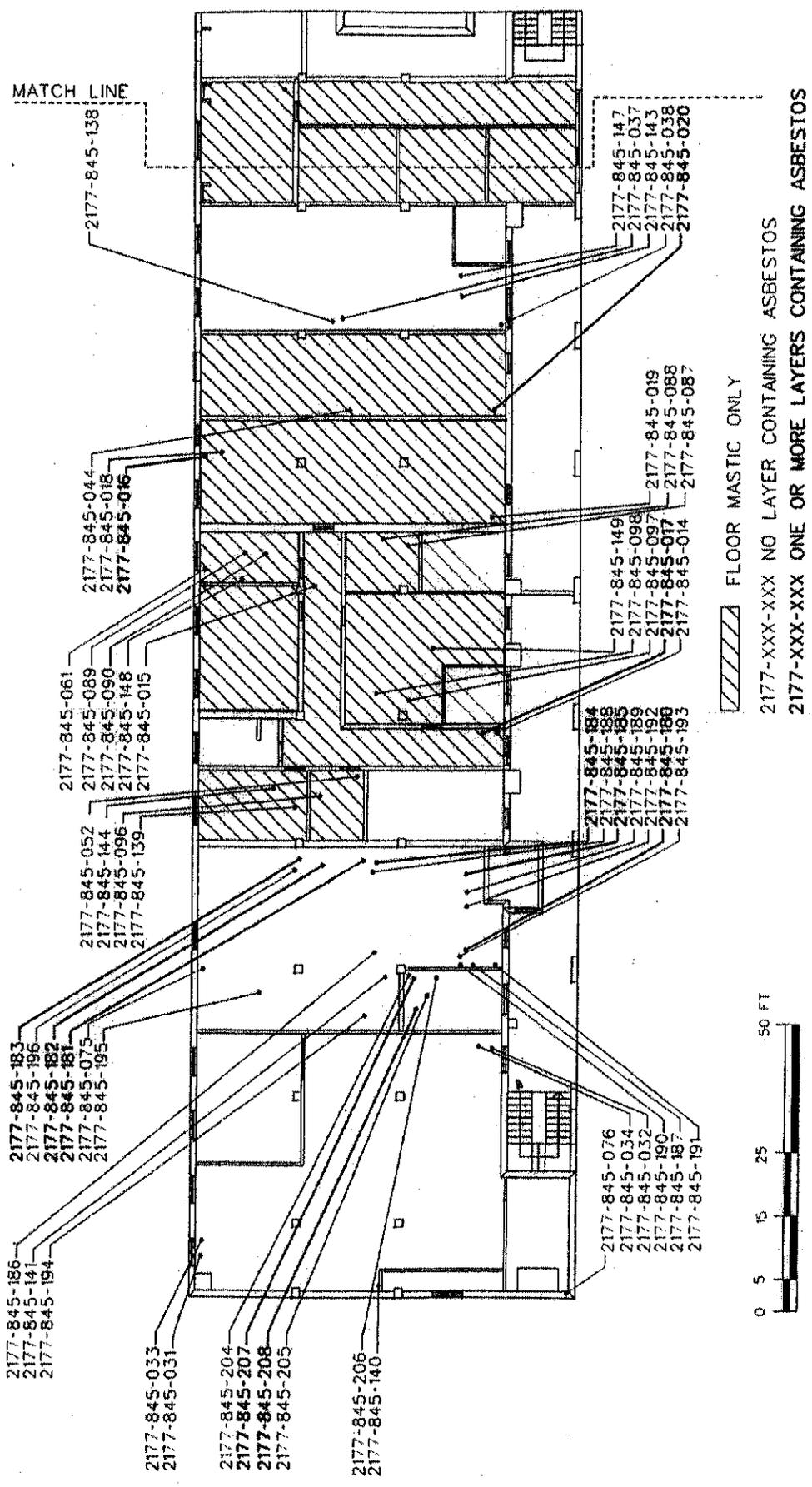
12" x 12" Grey with White Streaks Vinyl Floor Tile with Mastic
12" x 12" Tan with Brown Streaks Vinyl Floor Tile with Mastic - **Black**
12" x 12" Beige with Brown Streaks Vinyl Floor Tile with Mastic - **Black**
12" x 12" Beige with Grey Marbling Vinyl Floor Tile with Mastic - **Black**
12" x 12" Brown Vinyl Floor Tile with Mastic - **Black**
12" x 12" Blue Marbled Vinyl Floor Tile with Mastic
12" x 12" Off White Chalk Vinyl Floor Tile with Mastic - **Black**
12" x 12" White with Black Streaks Vinyl Floor Tile with Mastic
12" x 12" Olive Green with Black Streaks Vinyl Floor Tile with Mastic - **Black**
12" x 12" Medium Brown with Streaks Vinyl Floor Tile with Mastic - **Black**
12" x 12" Grey Marbled Vinyl Floor Tile with Mastic
12" x 12" Black Vinyl Floor Tile with Mastic
12" x 12" Grey/Green Marbled Vinyl Floor Tile with Mastic - **Black**
12" x 12" Green with White Streaks Vinyl Floor Tile with Mastic
12" x 12" Brick Red Vinyl Floor Tile with Mastic
12" x 12" Brown with Dark Brown Spots Vinyl Floor Tile with Mastic - **Black**
4" Burgundy Cove Base with Adhesive
4" Brown Cove Base with Adhesive
4" Black Cove Base with Adhesive
Gypsum Board with Joint Compound
Plaster with Skim Coat (See Remarks & Comments)
2' x 4' Acoustical Ceiling Tile, Pinhole Pattern
2' x 4' Acoustical Ceiling Tile, Random Pattern
2' x 4' Acoustical Ceiling Tile, Small Fissure Pattern
2' x 4' Acoustical Ceiling Tile, Fissure Pattern
1' x 2' Acoustical Ceiling Tile, Large Pinhole Pattern
Ceiling Insulation - Brown Spray-on
Wall Insulation
Window Caulking
Composition Roll Roofing Material - Main Roof
Composition Roll Roofing Material - Upper Roof
Composition Roll Roofing Material - Secondary Roof
Flashing - Main Roof at Elevated Walls
***Flashing - Main Roof at Flue/Stack - Silver Paint**

Mastic at Vents
Flashing at Access Hatch
Cementitious Panels - Eaves - *Grey Cementitious Asbestos Board*
Heater, Ventilation Air Conditioning (HVAC) Vibration Cloth
HVAC Vibration Cloth - White Woven Material - *White Fibrous Material
HVAC Duct Insulation
Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White Calcareous Matrix
Chilled Water Supply - Hanger - White Insulation - *Off White Soft Material with Paint
Chilled Water Supply - Fitting - *Off White Soft Material with Paint
Chilled Water Return - Hanger - White Insulation
Chilled Water Return - Fitting
Pipe Hanger Insulation - Chilled Water
Pipe Hanger Insulation - Chilled Water
Pipe Hanger Insulation - Chilled Water - *White Soft Material
Hot Water Tank Insulation
Hot Water Pipe Insulation - Elbow - *White Coating
Pipe Hanger Insulation - Chilled Water - *White Soft Material

MATCH LINE



2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DAC-83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 845

FIGURE
 E-3

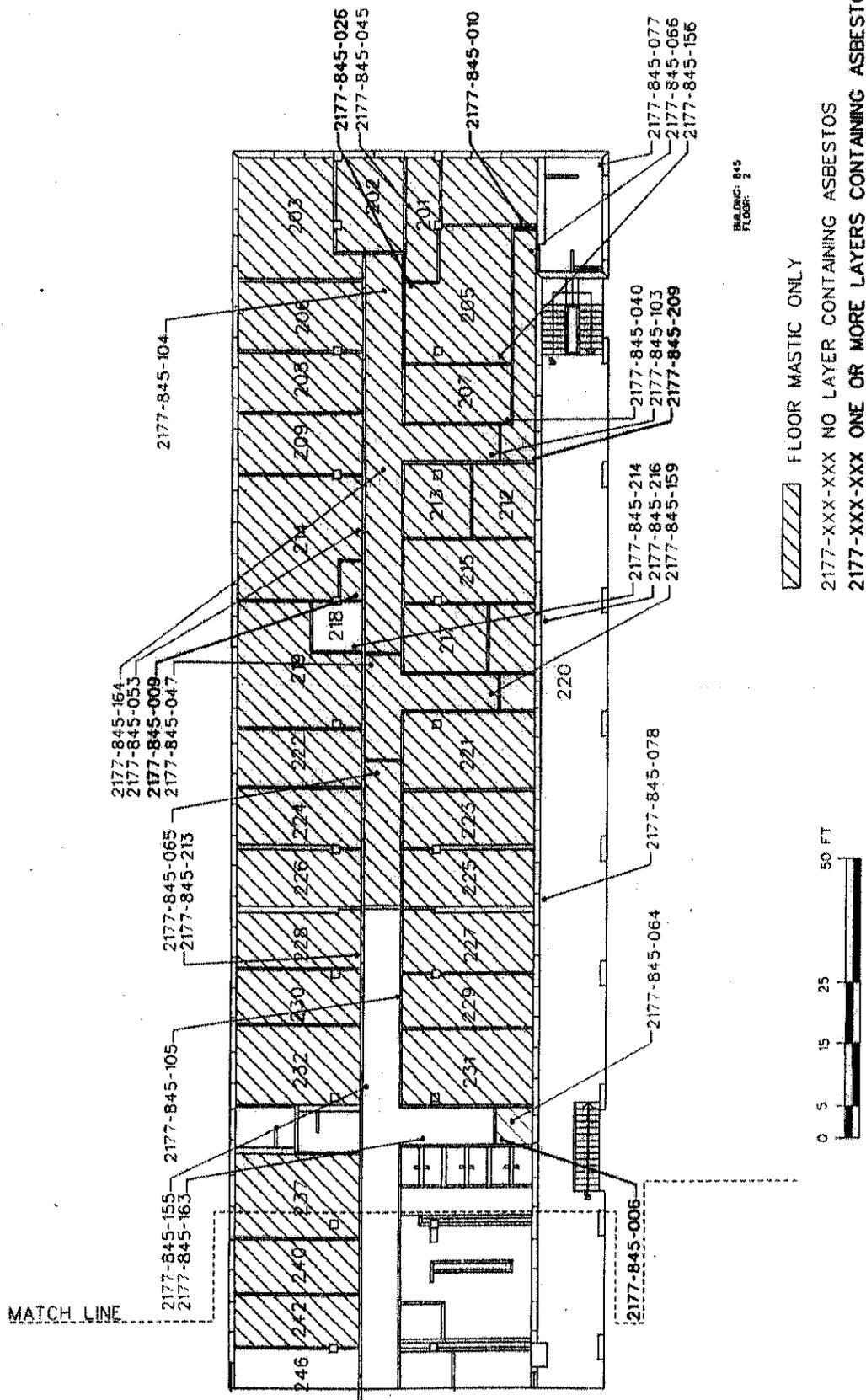
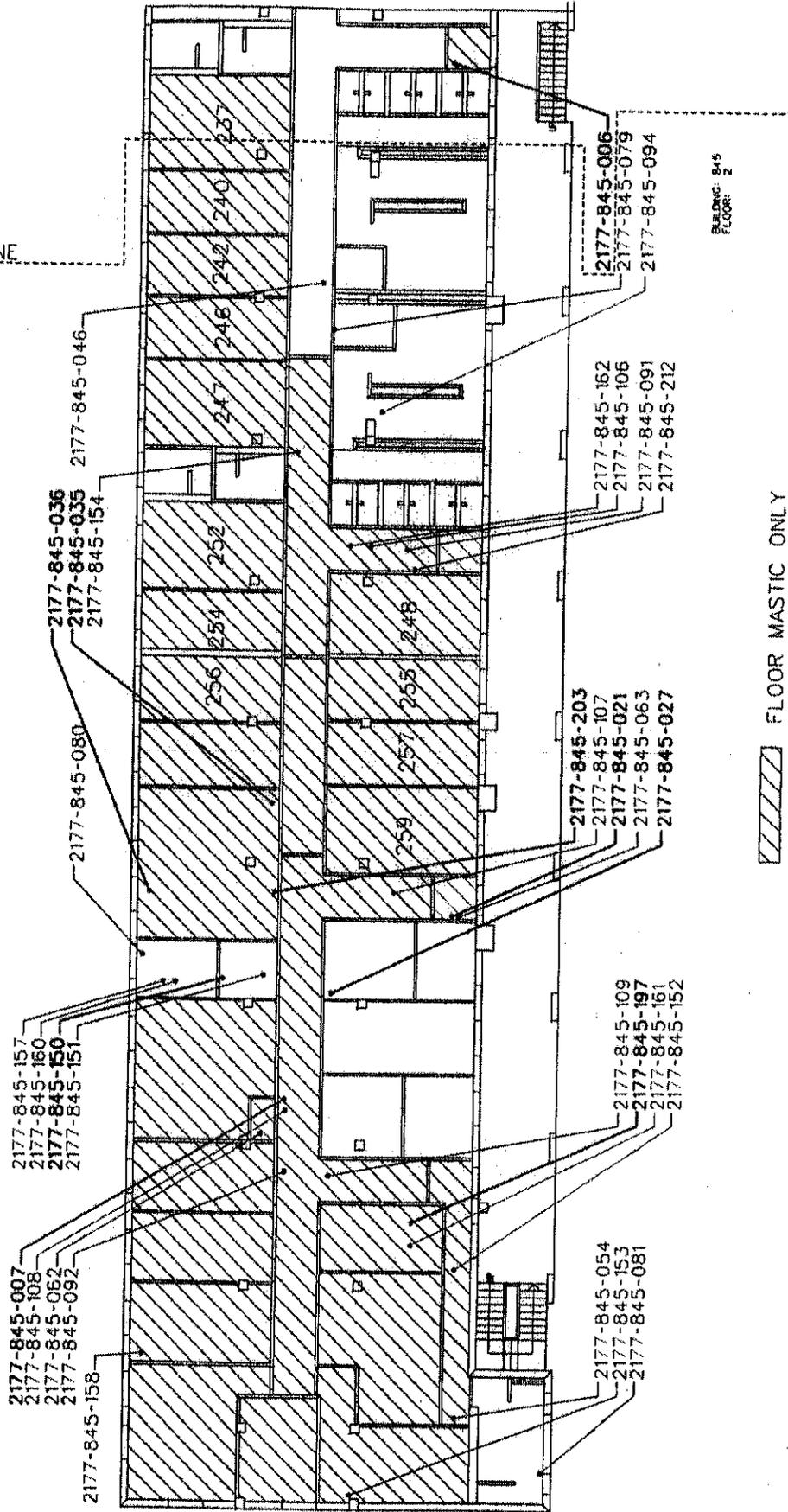


FIGURE E-4

Sample Location Plan
Building 845

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA83-00-D-0067, T.O. 0003

MATCH LINE



BUILDING: 845
FLOOR: 2

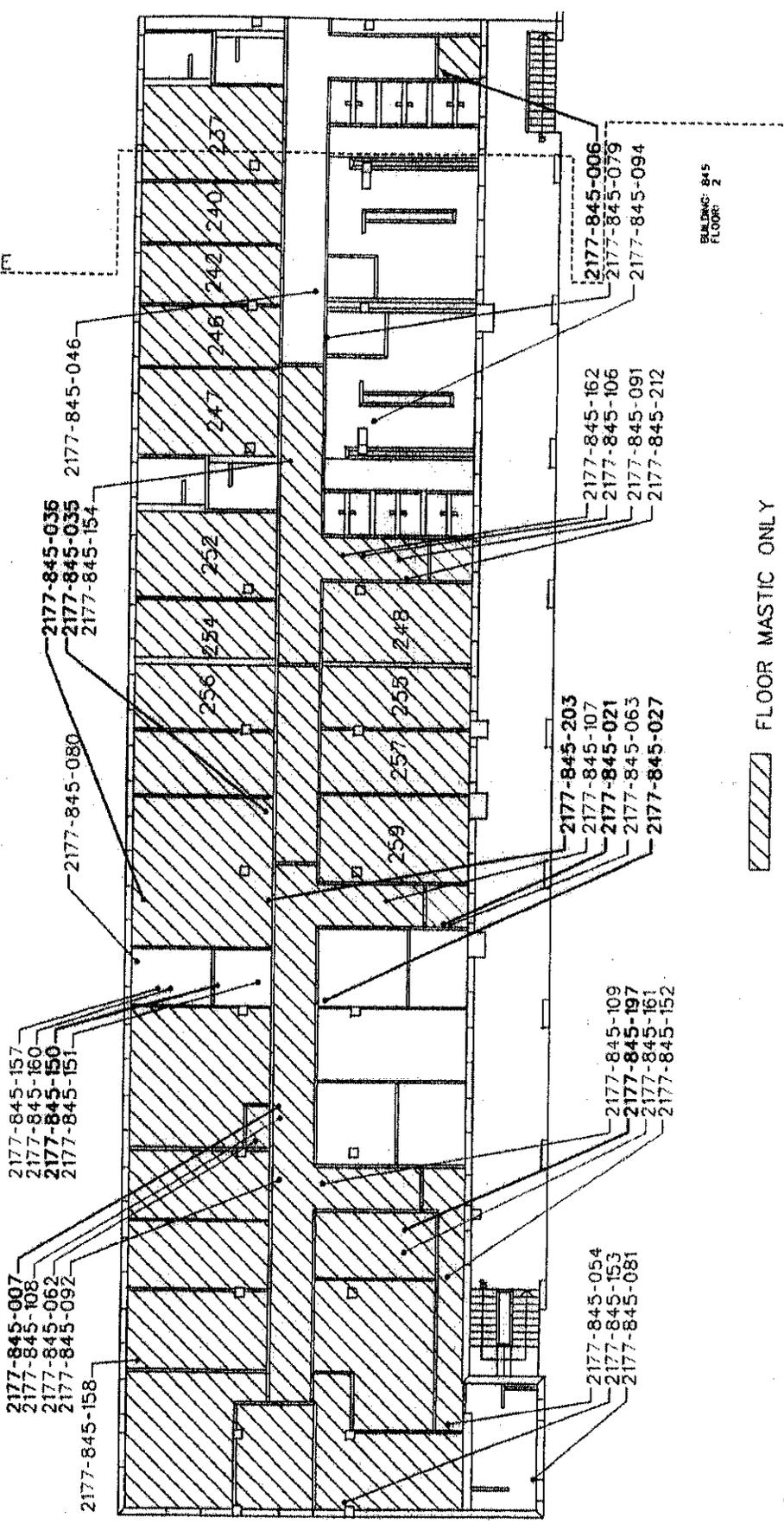
▨ FLOOR MASTIC ONLY

▨ 2177-XXX-XXX NO LAYER CONTAINING ASBESTOS

▨ 2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

0 5 15 25 50 FT

MATCH LINE



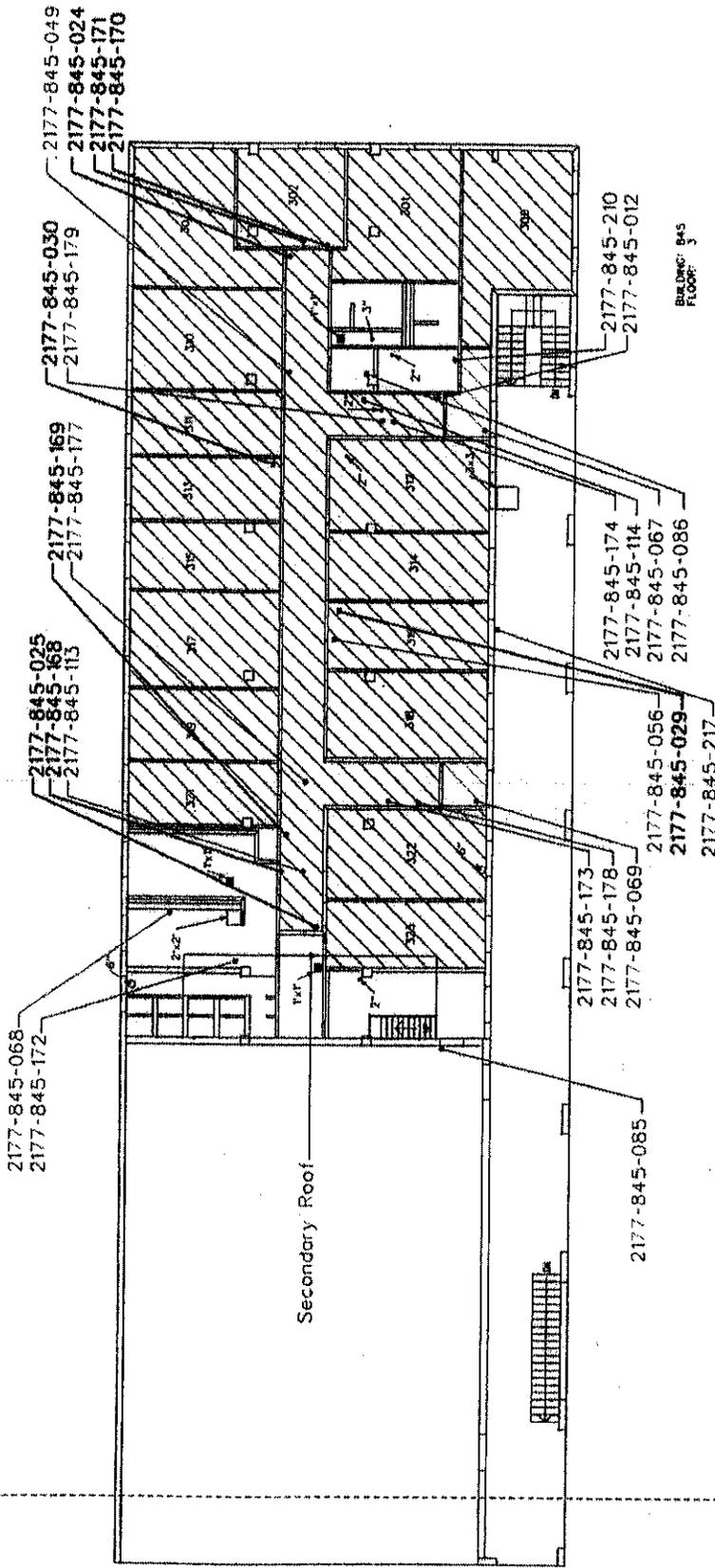
FLOOR MASTIC ONLY

2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS



BUILDING: 845
FLOOR: 2

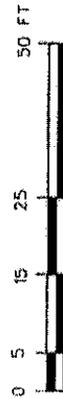
MATCH LINE

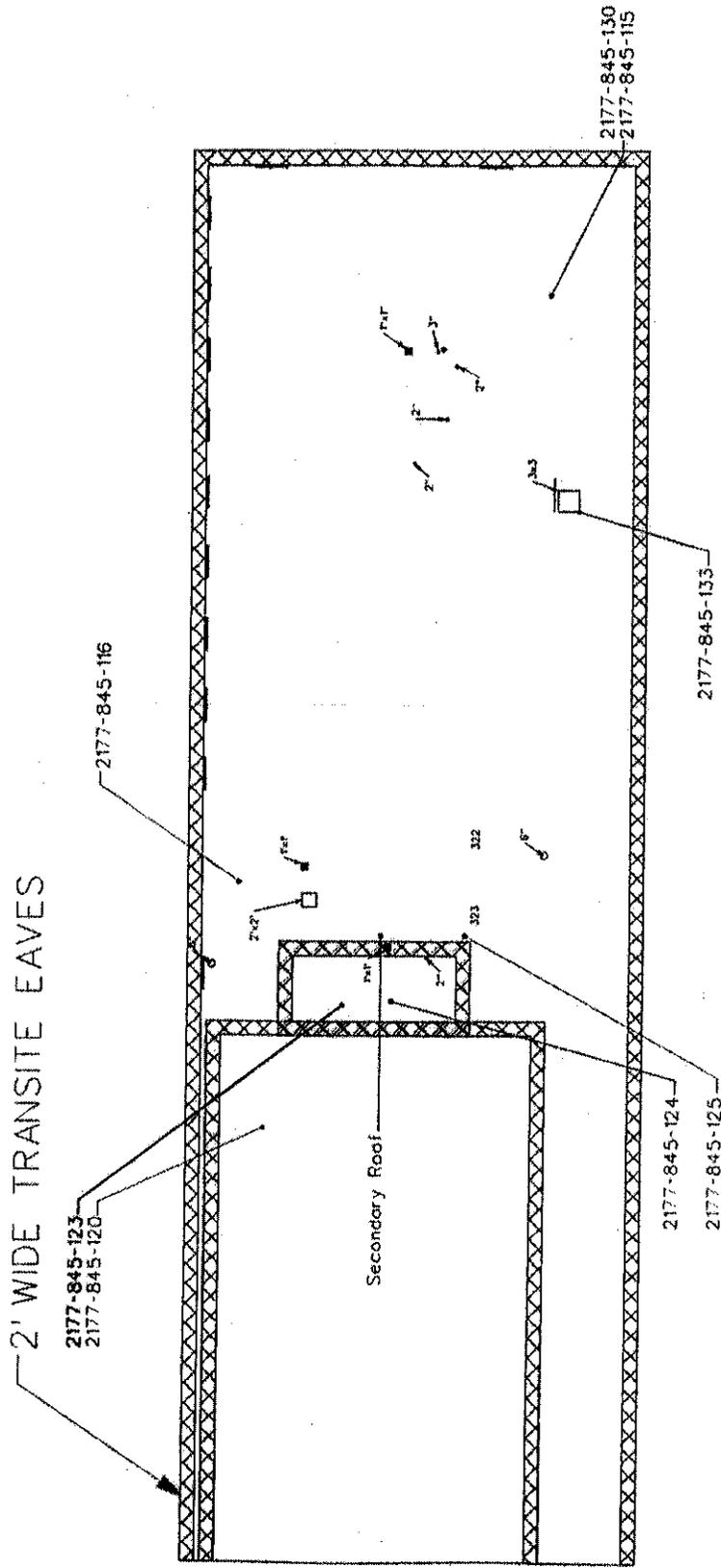


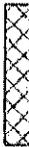
▨ FLOOR MASTIC ONLY

2177-XXX-XXX NO LAYER CONTAINING ASBESTOS

2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS



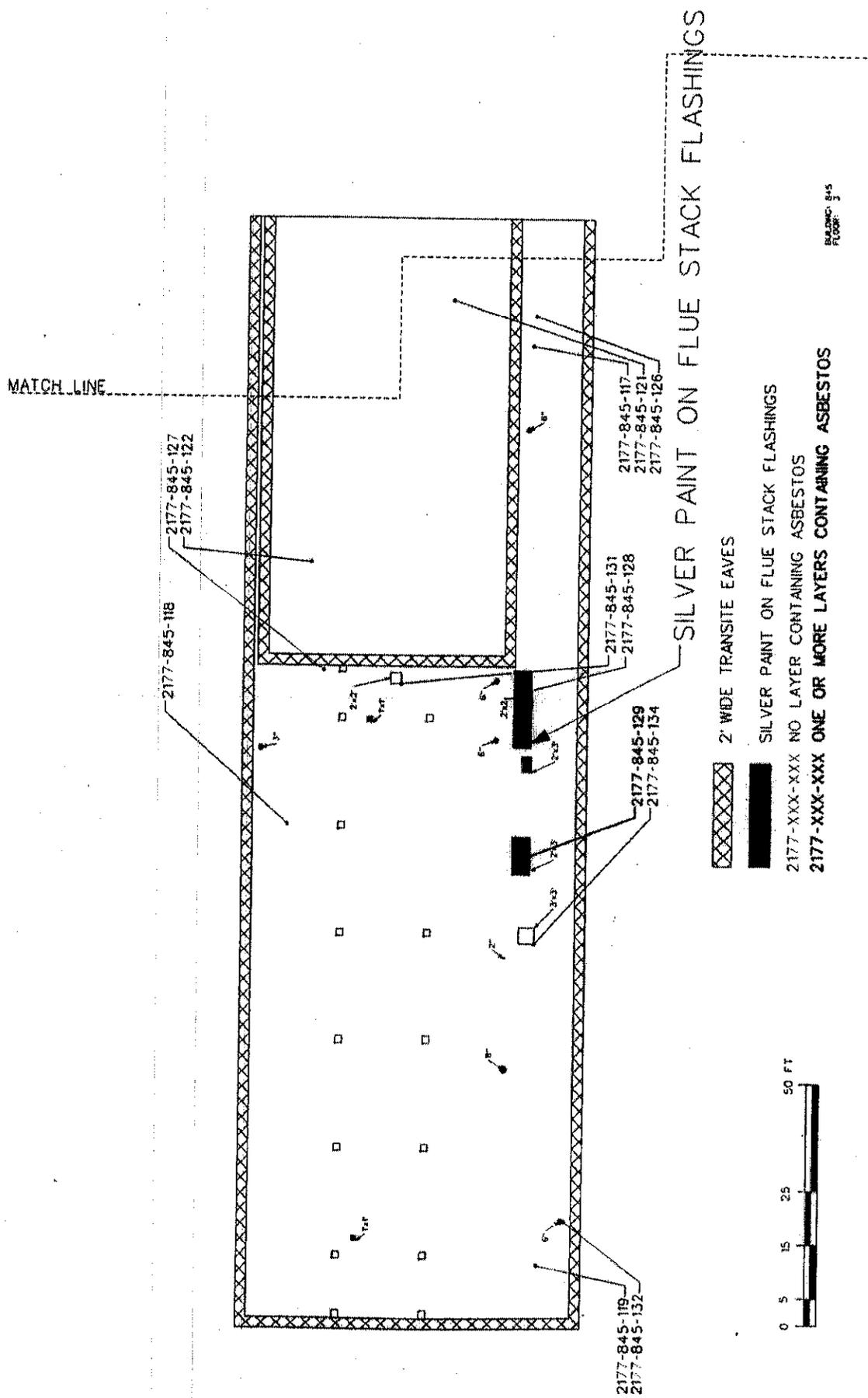


-  2' WIDE TRANSITE EAVES
-  SILVER PAINT ON FLUE STACK FLASHINGS
-  2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
-  2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 845

FIGURE
 E-8



BUILDING: 845
FLOOR: 3

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACAS3-00-D-0007, T.O. 0003

Sample Location Plan
Building 845

FIGURE
E-9

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: _____

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 3 OF 10

E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION	
							12" x 12"	12" x 12"
2177-845-025	B	3	Hallway	F2A	9	N	OLIVE Green w/Black Streak Vinyl Floor Tile with Mastic	
2177-845-026	B	2	201	F1A	10	O	Medium Brown w/Streak Vinyl Floor Tile with Mastic	
2177-845-027	B	2	Boiler Room Signals	F1A	10	O		
2177-845-028	B	3	351	F2A	10	P		
2177-845-029	B	3	316	F2A	10	P		
2177-845-030	B	3	313	F2A	10	P		
2177-845-031	B	1	Weight Room	F1A	11	Q	Grey Mashed Vinyl Floor Tile with Mastic	
2177-845-032	B	1	Weight Room	F1A	11	Q		
2177-845-033	B	1	Weight Room	F1A	12	R	Black Vinyl Floor Tile with Mastic	
2177-845-034	B	1	Weight Room	F1A	12	R		
2177-845-035	B	2	Boat Comp. Room	F2A	13	S	Grey/Green Mashed Vinyl Floor Tile with Mastic	
2177-845-036	B	2	Boat Comp. Room	F2A	13	S		

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS	ACCOUNTABILITY RECORD
	CH	AM	CR	AC	AN	TR		
200706011								
06012								
06013								
06014								
06015								
06016								
06017								
06018								
06019								
06020								
06021								
06022								

REQUESTED COMPLETION DATE: 5 day Lat

JOB NO. 2177-00F BATCH NO. EKNAG133 DATE: 07/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: [Signature]

TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL

LAB NAME: NYL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: Theo De

DATE: 7/31/00 TIME: 10:00 am INITIALS: _____

ANALYZED BY: _____

LAB O.C. APPROVAL: _____

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09428

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/29/00
SHEET 4 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-845-037	B	1			14	T	9" x 9" Green w/ White Strakes Vinyl Floor Tile with Mastic
2 2177-845-038	B	1			14	T	9" x 9" Green w/ White Strakes Vinyl Floor Tile with Mastic
3 2177-845-039	B	1			15	U	12" x 12" Brick Red Vinyl Floor Tile with Mastic
4 2177-845-040	B	2	207	FIA	15	V	12" x 12" Brick Red Vinyl Floor Tile with Mastic
5 2177-845-041	B	1			16	W	12" x 12" Brown w/ Dark Brown Spots Vinyl Floor Tile with Mastic
6 2177-845-042	B	1	Hallway	WA1	17	X	4" Burgandy Cove Base with Adhesive
7 2177-845-043	B	1	Hallway	WB1	18	Y	4" Brown Cove Base with Adhesive
8 2177-845-044	B	1	H.H.B. Supply	WD1	18	Y	
9 2177-845-045	B	2	201	WA1	18	Z	
10 2177-845-046	B	2	Hallway	WC1	18	Z	
11 2177-845-047	B	2	Hallway	WA1	18	Z	
12 2177-845-048	B	3	Hallway	WA1	18	AA	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CR	AM	CR	AC	AN	TR	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12 20076634							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-08F BATCH NO. E0N081333 DATE 07/29/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: *Thao Do*

DATE: 7/31/00 TIME: 10:00 AM INITIALS:

ANALYZED BY: *ST*

LAB Q.C. APPROVAL: *NL*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 5 OF 10

E-MAIL DATA: YES NO

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

BLDG. AND PROJECT NAME:

SAMPLE ID NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	3	Hallway	WA1	18	AA	4" Brown Cove Base with Adhesive
2	1	TV/Rc. Room	WC1	19	AB	4" Black Cove Base with Adhesive
3	1	OFFICE	WC1	19	AB	
4	1	HHS OFFICE	WB1	19	AB	
5	2	2JH	WC1	19	AC	
6	2	Hallway	WD1	19	AC	
7	3	346	WC1	19	AD	
8	3	316	WA1	19	AD	
9	1	Hallway	WB1	20	AE	Gypsum Board with Joint Compound
10	1	Hallway	WD1	20	AE	
11	1	PA 470V FF	WC1	20	AE	
12	1	Hallway	WPI	20	AE	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 217-00F BATCH NO. EKN0133 DATE: 07/29/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10 AM INITIALS:
 ANALYZED BY: *EE*
 LAB Q.C. APPROVAL: *AL*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 6 OF 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-845-061	B	1	Storage	WD1	20	AE	Gypsum Board with Joint Compound
2 2177-845-062	B	2	Telephone Closet	WD1	20	AF	
3 2177-845-063	B	2	Hallway Entry	WD1	20	AF	
4 2177-845-064	B	2	Hallway Entry	CIA	20	AF	
5 2177-845-065	B	2	Hallway	WAI	20	AF	
6 2177-845-066	B	2	Hallway	WCI	20	AF	
7 2177-845-067	B	3	Hallway Entry	CIA	20	AG	
8 2177-845-068	B	3	Corridor	WBI	20	AG	
9 2177-845-069	B	3	Hallway Entry	WD1	20	AG	
10 2177-845-070	B	3	Hallway Entry	CIA	20	AG	
11 2177-845-071	B	3	Corridor	WD1	20	AG	
12 2177-845-072	B	1	Exterior	WCI	21	AH	Plaster with Skim Coat

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CR	AM	CR	AC	AN	TR	
1 20076647							
2 6648							
3 6649							
4 6650							
5 6651							
6 6652							
7 6653							
8 6654							
9 6655							
10 6656							
11 6657							
12 6658							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 3177-00F BATCH NO. ECKA0133 DATE: 07/28/00
 CLIENT NAME: FLUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris* DELIVERED TO LAB BY: DHC
 TIME COMPLETED: 7:00
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10:00 INITIALS:
 ANALYZED BY: SP
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 1 OF 10

E-MAIL DATA: YES NO X

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	1	25th Flr Supply	WBI	21	AH	Plaster with Skim Coat
2	B	1	Rec. Room	WAI	21	AH	
3	B	1	Chiller Room	WAI	21	AH	
4	B	1	Exterior	WCI	21	AH	
5	B	2	Latrine	WCI	21	AI	
6	B	2	Exterior	WCI	21	AI	
7	B	2	Latrine	WAI	21	AI	
8	B	2	Elec. Room	WAI	21	AI	
9	B	2	Latrine	WCI	21	AI	
10	B	3	Latrine	WBI	21	AJ	
11	B	3	Exterior Column	WCI	21	AJ	
12	B	3	Fitness Center	WAI	21	AJ	

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION								COMMENTS	
	CH	AM	CR	AC	AN	TR				
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-00F BATCH NO. EKNAB133 DATE: 07/29/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: W. C. Harris
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DAL

LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98163
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10 AM INITIALS:
 ANALYZED BY: SP
 LAB O.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/18/00
SHEET 1 OF 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-845-085	3	Fitness Center	WB1	21	AJ	Plaster with Skim Coat
2 2177-845-084	3	Vanitor Cabinet	WC1	21	AJ	
3 2177-845-087	1	Bath X/O	C1A	22	AK	2' x 4' Acoustic Ceiling Tile, Pinhole Pattern
4 2177-845-088	1	Bath X/O	C1A	22	AK	
5 2177-845-089	1	Storage	C1A	23	AL	2' x 4' Acoustic Ceiling Tile, Random Pattern
6 2177-845-090	1	Storage	C1A	23	AL	
7 2177-845-091	2	Hallway	C1B	23	AM	
8 2177-845-092	2	Hallway	C1B	23	AM	
9 2177-845-093	3	Spec. Room	C1A	23	AN	
10 2177-845-094	3	Lounge	C1A	24	AO	2' x 4' Acoustic Ceiling Tile, Small Fissure Pattern
11 2177-845-095	3	Lounge	C1A	24	AO	
12 2177-845-096	1	OFFICE	C1A	25	AP	2' x 4' Acoustic Ceiling Tile, Fissure Pattern

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 20076671					
2 66672					
3 66673					
4 66674					
5 66675					
6 66676					
7 66677					
8 66678					
9 66679					
10 66680					
11 66681					
12 66682					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-00F BATCH NO. EKN81333 DATE: 07/18/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. C. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4788 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/13/02 TIME: 10 AM INITIALS:
 ANALYZED BY: ST
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, A, BR, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 9 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	1	Orderly Room	CIA	25	AP	2' x 4' Acoustic Ceiling Tile, Fissure Pattern
2	B	1	Orderly Room	CIA	25	AP	
3	B	1	Hallway	CIA	25	AP	
4	B	1	Hallway	CIA	25	AP	
5	B	1	Hallway	CIA	25	AP	
6	B	1	Hallway	CIA	25	AP	
7	B	2	Hallway	CIA	25	AQ	
8	B	2	Hallway	CIA	25	AQ	
9	B	2	Hallway	CIA	25	AQ	
10	B	2	Hallway	CIA	25	AQ	
11	B	2	Hallway	CIA	25	AQ	
12	B	2	Hallway	CIA	25	AQ	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CR	AM	AC	TR	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-88F BATCH NO. EKN401333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. C. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: PHC
 LAB NAME: NVL LABORATORIES, INC
 ADDRESS: 4788 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Thao D*
 DATE: 7/31/00 TIME: 10AM INITIALS:
 ANALYZED BY: *SB*
 LAB Q.C. APPROVAL: *NL*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/18/00
SHEET 10 OF 10

E-MAIL DATA: YES NO

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

B.D.C. AND PROJECT NAME:

SAMPLE ID NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 217-845-109	2	Hallway	C1A	25	AR	2' x 4' Acoustic Ceiling Tile, Fissure Pattern
2 217-845-110	3	Hallway	C1A	25	AR	
3 217-845-111	3	Hallway	C1A	25	AR	
4 217-845-112	3	Hallway	C1A	25	AR	
5 217-845-113	3	Hallway	C1A	25	AR	
6 217-845-114	3	Hallway	C1A	25	AR	
7 217-845-						
8 217-845-						
9 217-845-						
10 217-845-						
11 217-845-						
12 217-845-						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CR	AM	CR	AC	
1 20076695					
2 6696					
3 6697					
4 6698					
5 6699					
6 20076700					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-00F BATCH NO. ERNA01333 DATE 07/18/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARBUS, D. ITSDILL
 SIGNATURE: *W. C. Harbus*
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10:00 INITIALS:
 ANALYZED BY: SZ
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

(42) 00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 8-2-00
SHEET 7 OF 8

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 217-845	B						
2 217-845	B						
3 217-845	B						
4 217-845	B						
5 217-845	B						
6 217-845	B						
7 217-845-115	B	R	Roof	RIA	26	AS	Composition Roll Roofing Material - Main Roof
8 217-845-116	B	R	Roof	RIA	26	AS	
9 217-845-117	B	R	Roof	RIA	26	AS	
10 217-845-118	B	R	Roof	RIA	26	AS	
11 217-845-119	B	R	Roof	RIA	26	AS	
12 217-845-120	B	R	Roof	RIA	27	AT	Composition Roll Roofing Material - Upper Roof

FOUND

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 217-845-115					
2 217-845-116					
3 217-845-117					
4 217-845-118					
5 217-845-119					
6 217-845-120					
7 1067					
8 1068					
9 1069					
10 1070					
11 1071					
12 1072					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 217-845 BATCH NO. EEN081333 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: *FUNG*
 LAB NAME: NYL LABORATORIES, INC.
 ADDRESS: 4788 AURORA AVE. N. SEATTLE, WASHINGTON 98105
 RECEIVED BY: *Paul H. Hille*
 DATE: 08/04/00 TIME: 8:40 AM INITIALS: JP
 ANALYZED BY: *SE*
 LAB Q.C. APPROVAL: *ML*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-1009

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8-22-88
SHEET 2 OF 3

E-MAIL DATA: YES NO

SAMPLE ID. NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	R	Roof	R1A	27	AT	Composition Roll Roofing Material - Upper Roof
2	R	Roof	R1A	27	AT	↓ ↓ ↓ ↓ ↓ ↓
3	R	Roof	Eave	28	AV	Cementitious Panel - Eaves
4	R	Roof	R1A	29	AV	Composition Roll Roofing Material - Secondary Roof
5	R	Roof	R1B	30	AW	Flashing - Main Roof at Elevated walls
6	R	Roof	R1B	30	AW	↓ ↓ ↓ ↓ ↓ ↓
7	R	Roof	R1B	30	AW	↓ ↓ ↓ ↓ ↓ ↓
8	R	Roof	R1C	31	AX	Flashing - Main Roof at Flue/Stacks
9	R	Roof	R1C	31	AX	↓ ↓ ↓ ↓ ↓ ↓
10	R	Roof	R1D	32	AY	Mastic at Vents
11	R	Roof	R1D	32	AY	↓ ↓ ↓ ↓ ↓ ↓
12	R	Roof	R1D	32	AY	↓ ↓ ↓ ↓ ↓ ↓

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
20041073							
1074							
1075							
1076							
1077							
1078							
1079							
1080							
1081							
1082							
1083							
1084							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 217-00F BATCH NO. EKN01333 DATE: 8/2/88
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS D. TISDELL
 SIGNATURE: *W. Harris D. Tisdell*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: FedEx

LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4706 AUBORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Anthony...*
 DATE: 08-04-88 TIME: 8:40 AM INITIALS: JJP
 ANALYZED BY: SZ
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/08
SHEET 3 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET#	MATERIAL DESCRIPTION	
1 217-845-133	B	R	Roof	R1E	33	AZ	Flashing at Access Hatches	
2 217-845-134	B	R	Roof	R1E	33	AZ		
3 217-845-135	B	1	Plenum	C2A	34	BA	Joint Sealant/Mastic on Fiberglass Pipe Insulation	
4 217-845-136	B	1	Plenum	C2A	34	BA		
5 217-845-137	B	1	Plenum	C2A	34	BA		
6 217-845-138	B	1	Plenum	C2A	34	BA		
7 217-845-139	B	1	Plenum	C2A	34	BA		
8 217-845-140	B	1	Plenum	C2A	34	BA		
9 217-845-141	B	1	Plenum	C2A	34	BA		
10 217-845-142	B	1	Plenum	C2A	34	BA		
11 217-845-143	B	1	Plenum	C2B	35	BB		HVAC Vibration Cloth
12 217-845-144	B	1	Plenum	C2B	35	BB		

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
2008							
20081085							
1086							
1087							
1088							
1089							
1090							
1091							
1092							
1093							
1094							
1095							
1096							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 217-006 BATCH NO. EKN-A01333 DATE: 8/2/08
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: W. Harris, D. Tisdell
 TIME COMPLETED: 11:00 DELIVERED TO LAB BY: Fed X

LAB NAME: NTL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: [Signature]
 DATE: 8/2/08 TIME: 5:10 PM INITIALS: JTP
 ANALYZED BY: SE
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 8-2-00
SHEET 4 OF 8

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	1	Plenum	C2C	36	BC	HVAC DUCT Insulation
2	B	1	Plenum	C2C	36	BC	
3	B	1	Plenum	C2C	36	BC	
4	B	1	Plenum	C2C	36	BC	
5	B	1	Plenum	C2C	36	BC	
6	B	2	Plenum	C2A	34	BD	Joint Sealant / Mastic on Fiberglass Pipe Insulation
7	B	2	Plenum	C2A	34	BD	
8	B	2	Plenum	C2A	34	BD	
9	B	2	Plenum	C2A	34	BD	
10	B	2	Plenum	C2A	34	BD	
11	B	2	Plenum	C2A	34	BD	
12	B	2	Plenum	C2A	34	BD	

LAB ID NO.	ASBESTOS CONCENTRATION				COMMENTS	ACCOUNTABILITY RECORD
	CH	AM	CR	AC		
1						REQUESTED COMPLETION DATE: 5 Day TAT JOB NO. 2177-00F BATCH NO. EKN601333 DATE: 8/2/00 CLIENT NAME: FUNG ASSOCIATES SAMPLERS NAME: W. HARRIS, D. TISDELL SIGNATURE: <i>W. Harris</i> DELIVERED TO LAB BY: <i>FedX</i> TIME COMPLETED: 17:00 LAB NAME: NPL LABORATORIES, INC. ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103 RECEIVED BY: <i>Shelley Anderson / MC</i> DATE: 08/04/00 TIME: 8:40am INITIALS: JJP ANALYZED BY: <i>SR</i> LAB Q.C. APPROVAL: <i>ML</i> PROJECT MANAGERS APPROVAL:
2						
3						
4						
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ANALYTICAL LABORATORY RESULTS

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10043

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/00
SHEET 6 OF 8
E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-845-169	B	3	Plenum	C2A	34	BG	Joint Sealant/Mastic on Fiberglass Insulation
2 2177-845-170	B	3	Plenum	C2A	34	BG	
3 2177-845-171	B	3	Plenum	C2A	34	BG	
4 2177-845-172	B	3	Plenum	C2B	35	BH	HVAC Vibration Cloth
5 2177-845-173	B	3	Plenum	C2B	35	BH	
6 2177-845-174	B	3	Plenum	C2B	35	BH	
7 2177-845-175	B	3	Plenum	C2C	36	BI	DUCT Insulation
8 2177-845-176	B	3	Plenum	C2C	36	BI	
9 2177-845-177	B	3	Plenum	C2C	36	BI	
10 2177-845-178	B	3	Plenum	C2C	36	BI	
11 2177-845-179	B	3	Plenum	C2C	36	BI	
12 2177-845-180	B	1	Mech. Rm	PIA	37	BJ	Chilled water Supply - Hanger - White Insulation

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 2177-845-1123					
2 1124					
3 1125					
4 1126					
5 1127					
6 1128					
7 1129					
8 1130					
9 1131					
10 1132					
11 1133					
12 1134					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-00F BATCH NO. EENAD0133 DATE 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS D. TISELL
 SIGNATURE: W.H. Tisell
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: Fed X
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Edmund Tisell
 DATE: 08/07/00 TIME: 5:40 PM INITIALS: JTP
 ANALYZED BY: ML
 LAB Q.C. APPROVAL: ML
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10093

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/08
SHEET 2 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	1	Mech. Room	PIA	37	BJ	Chilled Water Supply - Hanger - White Insulation
2	B	1	Mech. Room	PIA	37	BJ	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
3	B	1	Mech. Room	PIA	38	BK	Chilled Water Supply - Fitting
4	B	1	Mech. Room	PIA	38	BK	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
5	B	1	Mech. Room	PIA	38	BK	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
6	B	1	Mech. Room	PIA	39	BL	Chilled Water Return - Hanger - White Insulation
7	B	1	Mech. Room	PIA	39	BL	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
8	B	1	Mech. Room	PIA	39	BL	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
9	B	1	Mech. Room	PIA	40	BM	Chilled Water Return - Fitting
10	B	1	Mech. Room	PIA	40	BM	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
11	B	1	Mech. Room	PIA	40	BM	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
12	B	1	Mech. Room	TLA	41	BN	Ceiling Insulation - Brown Spray-on

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	ASBESTOS CONCENTRATION				COMMENTS	ACCOUNTABILITY RECORD
	CH	AM	CR	AC		
1						REQUESTED COMPLETION DATE: 5 Day TAT JOB NO. 2177-06F BATCH NO. EKNAB133 DATE: 8/2/08 CLIENT NAME: FUNG ASSOCIATES SAMPLERS NAME: W. HARRIS, D. FISDELL SIGNATURE: <i>W.H. Harris</i> TIME COMPLETED: 1700 DELIVERED TO LAB BY: Fed X
2						LAB NAME: NVE LABORATORIES, INC. ADDRESS: 4788 AURORA AVE. N., SEATTLE, WASHINGTON 98103
3						RECEIVED BY: <i>Paul Johnson</i> / MVL DATE: 08/02/08 TIME: 5:40 AM INITIALS: JP
4						ANALYZED BY: <i>ML</i> LAB QC APPROVAL: <i>ML</i>
5						PROJECT MANAGERS APPROVAL:
6						
7						
8						
9						
10						
11						
12						

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10093

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLPG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/00
 SHEET 8 OF 8
 E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-845-193	B	1	Mech Room	C1A	41	BN	Ceiling Insulation - Brown Spray - ON
2 2177-845-194	B	1	Mech Room	C1A	41	BN	↓
3 2177-845-195	B	1	Mech Room	C1A	41	BN	↓
4 2177-845-196	B	1	Mech Room	C1A	41	BN	↓
5 2177-845-197	B	2		C2A	42	BO	HVAC Vibration Cloth - White Woven Material
6 2177-845-198	B	3	Booth Room	C2D	43	BP	1'x2' Acoustic Ceiling Tile, Large Pinhole Pattern
7 2177-845-199	B	3	Hallway	C2D	43	BP	↓
8 2177-845-200	B	3	Hallway	C2D	43	BP	↓
9 2177-845-	B						↓
10 2177-845-	B						
11 2177-845-	B						
12 2177-845-	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AH	CR	AC	AN	TR	
1 200561147							
2 1146							
3 1149							
4 1150							
5 1151							
6 1152							
7 1153							
8 1154							
9 1155							
10 1156							
11 1157							
12 1158							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day Lat
 JOB NO. 2177-00F BATCH NO. EKN40133 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TRIDELL
 SIGNATURE: W. Harris
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: Fed Ex
 LAB NAME: NVL LABORATORIES, INC
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: [Signature]
 DATE: 08/02/00 TIME: 8:40am INITIALS: J.P
 ANALYZED BY: [Signature]
 LAB O.C. APPROVAL: [Signature]
 PROJECT MANAGERS APPROVAL: [Signature]

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

0010465

DATE: 08/08/00
SHEET 1 OF 1

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B						
2	B						
3	B						
4	B						
5	B						
6	B						
7	B						
8	B						
9	B	1	Postoffice	C1A	44	BQ	Pipe Hanger Insulation - Chilled Water
10	B	1	Postoffice	C1A	45	BR	Pipe Hanger Insulation - Chilled Water
11	B	2	med Room	C1A	46	BS	Pipe Hanger Insulation - Chilled Water
12	B	1	med Room	Hot Water Tank	47	BT	Hot Water Tank Insulation - Top

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1							
2							
3							
4							
5							
6							
7							
8							
9	20083605						
10	3666						
11	3667						
12	3668						

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 PA 7 Tot

JOB NO. 21770F BATCH NO. ERNAG133 DATE: 08/08/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: *W. Harris*

TIME COMPLETED: 16:30 DELIVERED TO LAB BY: FedEx

LAB NAME: NYE LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: *Thom*

DATE: 8/11/00 TIME: 8:30am INITIALS: TG

ANALYZED BY: *Marc Long*

LAB Q.C. APPROVAL: *NL*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09428

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 4 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-845-037	1			14	T	9" x 9" Green w/ White Streak Vinyl Floor Tile with Mastic
2 2177-845-038	1			14	T	
3 2177-845-039	1			15	U	12" x 12" Brick Red Vinyl Floor Tile with Mastic
4 2177-845-040	2	207	F1A	15	Y	
5 2177-845-041	1			16	W	12" x 12" Brown w/ Dark Brown Spots Vinyl Floor Tile with Mastic
6 2177-845-042	1	Hallway	WA1	17	X	4" Burgandy Cove Base with Adhesive
7 2177-845-043	1	Hallway	WB1	18	Y	4" Brown Cove Base with Adhesive
8 2177-845-044	1	H H B Supply	WD1	18	Y	
9 2177-845-045	2	201	WA1	18	Z	
10 2177-845-046	2	Hallway	WC1	18	Z	
11 2177-845-047	2	Hallway	WA1	18	Z	
12 2177-845-048	3	Hallway	WA1	18	AA	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12 20076634					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT

JOB NO. 2177-00F BATCH NO. EKNAB1333 DATE: 07/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: *W. Harris* *D. Tisdell*

TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: Thao Do

DATE: 7/31/00 TIME: 10:00 AM. INITIALS: SD

ANALYZED BY: ST

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09925

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 5 OF 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	3	Hallway	WAI	18	AA	4" Brown Cove Base with Adhesive
2	B	1	TV/Rec. Room	WCI	19	AB	4" Black Cove Base with Adhesive
3	B	1	OFFICE	WCI	19	AB	
4	B	1	HAB OFFICE	WBI	19	AB	
5	B	2	214	WCI	19	AC	
6	B	2	Hallway	WDI	19	AC	
7	B	3	346	WCI	19	AD	
8	B	3	316	WAI	19	AD	
9	B	1	Hallway	WBI	20	AE	Gypsum Board with Joint Compound
10	B	1	Hallway	WDI	20	AE	
11	B	1	PAC # 78N FF	WCI	20	AE	
12	B	1	Hallway	WDI	20	AE	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Pm 7/17
 JOB NO. 2177-00F BATCH NO. EKNAB1333 DATE: 07/29/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: [Signature]
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Theo Do TIME: 10 AM INITIALS:
 ANALYZED BY: SR
 LAB Q.C. APPROVAL: ML
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/29/00
SHEET 1 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-845-061	B	1	Storage	WD1	20	AE	Gypsum Board with Joint Compound
2 2177-845-062	B	2	Telephone Closet	WD1	20	AF	
3 2177-845-063	B	2	Hallway Entry	WD1	20	AF	
4 2177-845-064	B	2	Hallway Entry	C1A	20	AF	
5 2177-845-065	B	2	Hallway	WAI	20	AF	
6 2177-845-066	B	2	Hallway	WCI	20	AF	
7 2177-845-067	B	3	Hallway Entry	C1A	20	AG	
8 2177-845-068	B	3	Latrine	WBI	20	AG	
9 2177-845-069	B	3	Hallway Entry	WD1	20	AG	
10 2177-845-070	B	3	Hallway Entry	C1A	20	AG	
11 2177-845-071	B	3	Latrine	WD1	20	AG	
12 2177-845-072	B	1	Exterior	WCI	21	AH	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION								COMMENTS	ACCOUNTABILITY RECORD
	CH	AM	CR	AC	AN	TR	TH	TL		
1 20076647										REQUESTED COMPLETION DATE: 5 day TAT
2 6648										JOB NO. 2177-00E BATCH NO. ESKA01333 DATE: 07/29/00
3 6649										CLIENT NAME: FUNG ASSOCIATES
4 6650										SAMPLERS NAME: W. HARRIS, D. TISDELL
5 6651										SIGNATURE: <i>[Signature]</i>
6 6652										TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL
7 6653										LAB NAME: NVL LABORATORIES, INC.
8 6654										ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
9 6655										RECEIVED BY: Thao Do
10 6656										DATE: 7/31/00 TIME: 10AM INITIALS:
11 6657										ANALYZED BY: SE
12 6658										LAB Q.C. APPROVAL: NL

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 1 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-845-073	B	1	25th Flr Supply	WBI	21	AH	Plaster with Skim Coat
2 2177-845-074	B	1	Rec. Room	WAI	21	AH	
3 2177-845-075	B	1	Ch. Mr. Room	WAI	21	AH	
4 2177-845-076	B	1	Exterior	WCI	21	AH	
5 2177-845-077	B	2	Lathrine	WCI	21	AI	
6 2177-845-078	B	2	Exterior	WCI	21	AI	
7 2177-845-079	B	2	Lathrine	WAI	21	AI	
8 2177-845-080	B	2	Elec. Room	WAI	21	AI	
9 2177-845-081	B	2	Lathrine	WCI	21	AI	
10 2177-845-082	B	3	Lathrine	WBI	21	AJ	
11 2177-845-083	B	3	Exterior Column	WCI	21	AJ	
12 2177-845-084	B	3	Fitness Center	WAI	21	AJ	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1 200716659							
2 66660							
3 66661							
4 66662							
5 66663							
6 66664							
7 66665							
8 66666							
9 66667							
10 66668							
11 66669							
12 66670							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-00F BATCH NO. ERNA01333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. C. Harris & D. Tisdell*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL

LAB NAME: NYE LABORATORIES, INC.

ADDRESS: 4700 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: Theo Do

DATE: 7/31/00 TIME: 10 AM INITIALS:

ANALYZED BY: SB

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 8 OF 10

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

E-MAIL DATA: YES NO

SAMPLE ID NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	3	Fitness Center	WB1	21	AJ	Plaster with Skim Coat
2	3	Jogger Cabin	WC1	21	AJ	
3	1	Bath X/O	C1A	22	AK	2'x4' Acoustic Ceiling Tile, Pinhole Pattern
4	1	Bath X/O	C1A	22	AK	
5	1	Storage	C1A	23	AL	2'x4' Acoustic Ceiling Tile, Random Pattern
6	1	Storage	C1A	23	AL	
7	2	Hallway	C1B	23	AM	
8	2	Hallway	C1B	23	AM	
9	3	Spec. Room	C1A	23	AN	
10	3	Latrine	C1A	24	AO	2'x4' Acoustic Ceiling Tile, Small Fissure Pattern
11	3	Latrine	C1A	24	AO	
12	1	OFFICE	C1A	25	AP	2'x4' Acoustic Ceiling Tile, Fissure Pattern

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
20076671					
6672					
6673					
6674					
6675					
6676					
6677					
6678					
6679					
6680					
6681					
6682					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-08F BATCH NO. EKN091333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL.
 SIGNATURE: *W. C. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: JHL
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/28/00 TIME: 10 AM INITIALS:
 ANALYZED BY: ST
 LAB O.C. APPROVAL: NLC
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 9 OF 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	1	Ordinary Room	CIA	25	AP	2' x 4' Acoustic Ceiling Tile, Fissure Pattern
2	B	1	Ordinary Room	CIA	25	AP	
3	B	1	Hallway	CIA	25	AP	
4	B	1	Hallway	CIA	25	AP	
5	B	1	Hallway	CIA	25	AP	
6	B	1	Hallway	CIA	25	AP	
7	B	2	Hallway	CIA	25	AG	
8	B	2	Hallway	CIA	25	AG	
9	B	2	Hallway	CIA	25	AG	
10	B	2	Hallway	CIA	25	AG	
11	B	2	Hallway	CIA	25	AG	
12	B	2	Hallway	CIA	25	AG	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1	20057	60683					
2	6684						
3	6685						
4	6686						
5	6687						
6	6688						
7	6689						
8	6690						
9	6691						
10	6692						
11	6693						
12	6694						

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT

JOB NO. 2177-006 BATCH NO. EKN01333 DATE: 07/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: *W. C. Harris* DELIVERED TO LAB BY: *PHC*

TIME COMPLETED: 07:00

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: *Thao Do*

DATE: 7/31/00 TIME: 10AM INITIALS:

ANALYZED BY: *SB*

LAB Q.C. APPROVAL: *NL*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

00-09928

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 10 of 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 217-845-109	B	2	Hallway	C1A	25	AR	2' x 4' Acoustic Ceiling Tile, Fissure Pattern
2 217-845-110	B	3	Hallway	C1A	25	AR	
3 217-845-111	B	3	Hallway	C1A	25	AR	
4 217-845-112	B	3	Hallway	C1A	25	AR	
5 217-845-113	B	3	Hallway	C1A	25	AR	
6 217-845-114	B	3	Hallway	C1A	25	AR	
7 217-845-	B						
8 217-845-	B						
9 217-845-	B						
10 217-845-	B						
11 217-845-	B						
12 217-845-	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CR	AM	CR	AC	AN	TR	
1 20076695							
2 6696							
3 6697							
4 6698							
5 6699							
6 20076700							
7							
8							
9							
10							
11							
12							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-08F BATCH NO. EKN001333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS D. TISDELL
 SIGNATURE: *W. Harris D. Tisdell*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NYL LABORATORIES, INC.
 ADDRESS: 4788 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10:00 INITIALS:
 ANALYZED BY: SZ
 LAB Q.C. APPROVAL: NL
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

(42) 00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 6-2-00
SHEET 7 OF 5

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B						
2	B						
3	B						
4	B						
5	B						
6	B						
7	B	R	Roof	RIA	Z6	AS	Composition Roll Roofing Material - Main Roof
8	B	R	Roof	RIA	Z6	AS	
9	B	R	Roof	RIA	Z6	AS	
10	B	R	Roof	RIA	Z6	AS	
11	B	R	Roof	RIA	Z6	AS	
12	B	R	Roof	RIA	Z7	AT	Composition Roll Roofing Material - Upper Roof

FIELD

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day FAT
 JOB NO. 217-006 BATCH NO. EKN401333 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: FAX

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON, 98103

RECEIVED BY: *[Signature]*

DATE: 06/02/00 TIME: 8:40 AM INITIALS: JP

ANALYZED BY: SA

LAB Q.C. APPROVAL: *[Signature]*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-1008

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8-2-00
SHEET 3 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	R	Roof	R1A	27	AT	Composition Roll Roofing Material - Upper Roof
2	B	R	Roof	R1A	27	AT	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
3	B	R	Roof	Eave	28	AU	Compositions Panel - Eaves
4	B	R	Roof	R1A	29	AV	Composition Roll Roofing Material - Secondary Roof
5	B	R	Roof	R1B	30	AW	Flashing - Main Roof at Elevated Walls
6	B	R	Roof	R1B	30	AW	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
7	B	R	Roof	R1B	30	AW	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
8	B	R	Roof	R1C	31	AX	Flashing - Main Roof at Flue/Stacks
9	B	R	Roof	R1C	31	AX	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
10	B	R	Roof	R1D	32	AY	Mastic at Vents
11	B	R	Roof	R1D	32	AY	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
12	B	R	Roof	R1D	32	AY	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
2008-1073							
1074							
1075							
1076							
1077							
1078							
1079							
1080							
1081							
1082							
1083							
1084							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT

JOB NO. 217-08F BATCH NO. EGN46133 DATE: 8/2/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: *W. Harris*

TIME COMPLETED: 17:00 DELIVERED TO LAB BY: FedEx

LAB NAME: NYL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: *Paula...*

DATE: 08:00 AM TIME: 5:40 AM INITIALS: JP

ANALYZED BY: SE

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and I, SCHOFIELD.

DATE: 8/2/00
SHEET 3 OF 3

E-MAIL DATA: YES NO

SAMPLE LB. NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
2	B	R	Roof	R1E	33	AZ	
3	B	1	Plenum	C2A	34	BA	Joint Sealant/Mastic on Fiberglass Pipe Insulation
4	B	1	Plenum	C2A	34	BA	
5	B	1	Plenum	C2A	34	BA	
6	B	1	Plenum	C2A	34	BA	
7	B	1	Plenum	C2A	34	BA	
8	B	1	Plenum	C2A	34	BA	
9	B	1	Plenum	C2A	34	BA	
10	B	1	Plenum	C2B	35	BB	
11	B	1	Plenum	C2B	35	BB	
12	B	1	Plenum	C2B	35	BB	

ANALYTICAL LABORATORY RESULTS

LAB LB. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
2008							
2008-1085							
1086							
1087							
1088							
1089							
1090							
1091							
1092							
1093							
1094							
1095							
1096							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 217-00F BATCH NO. EKN00133 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. C. Harris, D. D. Tisdell*
 TIME COMPLETED: 01:00 DELIVERED TO LAB BY: Fed X

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4705 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: *Delgado*

DATE: 8/2/00 TIME: 5:40 AM INITIALS: JP

ANALYZED BY: SB

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

(42) 00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: **ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.**

DATE: **8-2-00**
SHEET **1** OF **5**

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 217-845	B						
2 217-845	B						
3 217-845	B						
4 217-845	B						
5 217-845	B						
6 217-845	B						
7 217-845-115	B	R	Roof	RIA	26	AS	Composition Roll Roofing Material - Main Roof
8 217-845-116	B	R	Roof	RIA	26	AS	
9 217-845-117	B	R	Roof	RIA	26	AS	
10 217-845-118	B	R	Roof	RIA	26	AS	
11 217-845-119	B	R	Roof	RIA	26	AS	
12 217-845-120	B	R	Roof	RIA	27	AT	Composition Roll Roofing Material - Upper Roof

FAPD

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 2008					
2					
3					
4					
5					
6					
7 1067					
8 1068					
9 1069					
10 1070					
11 1071					
12 1072					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: **5 Day 1997**
 JOB NO. **217-08E** BATCH NO. **EN-010333** DATE: **8/2/00**
 CLIENT NAME: **FUNG ASSOCIATES**
 SAMPLERS NAME: **W. HARRIS D. TISDELL**
 SIGNATURE: *[Signature]*
 TIME COMPLETED: **17:00** DELIVERED TO LAB BY: **Fed X**
 LAB NAME: **NVL LABORATORIES, INC.**
 ADDRESS: **4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103**
 RECEIVED BY: *[Signature]*
 DATE: **08/01/00** TIME: **8:10am** INITIALS: **JP**
 ANALYZED BY: **SZ**
 LAB Q.C. APPROVAL: *[Signature]*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10082

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 8-2-00
SHEET 2 OF 3

E-MAIL DATA: YES NO

BLOC. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	R	Roof	R1A	27	AT	Composition Roll Roofing Material - Upper Roof ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
2	B	R	Roof	R1A	27	AT	
3	B	R	Roof	Eave	28	AU	
4	B	R	Roof	R1A	29	AV	
5	B	R	Roof	R1B	30	AW	
6	B	R	Roof	R1B	30	AW	
7	B	R	Roof	R1B	30	AW	
8	B	R	Roof	R1C	31	AX	
9	B	R	Roof	R1C	31	AX	
10	B	R	Roof	R1D	32	AY	
11	B	R	Roof	R1D	32	AY	
12	B	R	Roof	R1D	32	AY	

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
20841073					
1074					
1075					
1070					
1077					
1078					
1079					
1080					
1081					
1082					
1083					
1084					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 217-06 BATCH NO. EKN01333 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 17.00 DELIVERED TO LAB BY: *FedX*

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 7708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: *John Johnson*

DATE: 08-04-00 TIME: 8:40 AM INITIALS: JH

ANALYZED BY: *SE*

LAB O.C. APPROVAL: *AL*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10092

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION	DATE: 8/2/00	SHEET 3 OF 3	E-MAIL DATA:	
										YES	NO
1	B	R	Roof	R1E	33	AZ	Flashing at Access Hatches				X
2	B	R	Roof	R1E	33	AZ					
3	B	1	Plenum	C2A	34	BA	Joint Sealant/Mastic on Fiberglass Pipe Insulation				
4	B	1	Plenum	C2A	34	BA					
5	B	1	Plenum	C2A	34	BA					
6	B	1	Plenum	C2A	34	BA					
7	B	1	Plenum	C2A	34	BA					
8	B	1	Plenum	C2A	34	BA					
9	B	1	Plenum	C2A	34	BA					
10	B	1	Plenum	C2B	35	BB	HVAC Vibration Cloth				
11	B	1	Plenum	C2B	35	BB					
12	B	1	Plenum	C2B	35	BB					

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION								COMMENTS
	CH	AM	CR	AC	AN	TR			
2008									
20081085									
1086									
1087									
1088									
1089									
1090									
1091									
1092									
1093									
1094									
1095									
1096									

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 2177-08F BATCH NO. EKNAD133 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. HISELL
 SIGNATURE: *W. Harris, D. Hiseill*
 TIME COMPLETED: 8/2/00 DELIVERED TO LAB BY: FedEx
 LAB NAME: NYL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Ed Koda*
 DATE: 8/2/00 TIME: 5:40 AM INITIALS: JK
 ANALYZED BY: SE
 LAB Q.C. APPROVAL: ML
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-1009A

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD 1 and J. SCHOFIELD.

DATE: 8-2-00
SHEET 4 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	1	Plenum	C2C	36	BC	HVAC DUCT Insulation
2	B	1	Plenum	C2C	36	BC	
3	B	1	Plenum	C2C	36	BC	
4	B	1	Plenum	C2C	36	BC	
5	B	1	Plenum	C2C	36	BC	
6	B	2	Plenum	C2A	34	BD	Joint Sealant / Mastic on Fiberglass Pipe Insulation
7	B	2	Plenum	C2A	34	BD	
8	B	2	Plenum	C2A	34	BD	
9	B	2	Plenum	C2A	34	BD	
10	B	2	Plenum	C2A	34	BD	
11	B	2	Plenum	C2A	34	BD	
12	B	2	Plenum	C2A	34	BD	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CF	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day 7AT
 JOB NO. 2177-00F BATCH NO. EKNAD1333 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: W. C. Harris, D. Tisdell
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: FedEx

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4788 AUROREA AVE. N. SEATTLE, WASHINGTON 98108

RECEIVED BY: [Signature]

DATE: 08-04-00 TIME: 6:40am INITIALS: JJP

ANALYZED BY: SZ

LAB Q.C. APPROVAL: [Signature]

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

(44) 00-10093

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHIOPFIELD.

DATE: 8/21/88
SHEET 5 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	2	Plenum	C2B	35	BE	HVAC Vibration Cloth
2	B	2	Plenum	C2B	35	BE	
3	B	2	Plenum	C2B	35	BE	
4	B	2	Plenum	C2C	36	BF	HVAC DUCT Insulation
5	B	2	Plenum	C2C	36	BF	
6	B	2	Plenum	C2C	36	BF	
7	B	2	Plenum	C2C	36	BF	
8	B	2	Plenum	C2C	36	BF	
9	B	3	Plenum	C2A	34	BG	Joint Sealant/Mastic on Fiberglass Pipe Insulation
10	B	3	Plenum	C2A	34	BG	
11	B	3	Plenum	C2A	34	BG	
12	B	3	Plenum	C2A	34	BG	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day 7A7

JOB NO. 2177-00F BATCH NO. E03A01333 DATE:

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: *W. Harris* DELIVERED TO LAB BY: *Ed X*

TIME COMPLETED: 17:00

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 ALBUQUERQUE AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: *Paula...*

DATE: 08/24/88 TIME: 8:40am INITIALS: JP

ANALYZED BY: *mm*

LAB Q.C. APPROVAL: *ML*

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10043

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/00
 SHEET 6 OF 8
 E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-845-169	B	3	Plenum	C2A	34	BG	Joint Sealant/Plastic on Fiberglass Insulation
2 2177-845-170	B	3	Plenum	C2A	34	BG	
3 2177-845-171	B	3	Plenum	C2A	34	BG	
4 2177-845-172	B	3	Plenum	C2B	35	BH	HVAC Vibration Cloth
5 2177-845-173	B	3	Plenum	C2B	35	BH	
6 2177-845-174	B	3	Plenum	C2B	35	BH	
7 2177-845-175	B	3	Plenum	C2C	36	BT	HVAC DUCT Insulation
8 2177-845-176	B	3	Plenum	C2C	36	BT	
9 2177-845-177	B	3	Plenum	C2C	36	BT	
10 2177-845-178	B	3	Plenum	C2C	36	BT	
11 2177-845-179	B	3	Plenum	C2C	36	BT	
12 2177-845-180	B	1	Mech. Rm	P 1A	37	BJ	Chilled Water Supply - Hanger - White Insulation

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CR	AM	AC	TR	
1 2177-845-1123					
2 1124					
3 1125					
4 1126					
5 1127					
6 1128					
7 1129					
8 1130					
9 1131					
10 1132					
11 1133					
12 1134					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-00F BATCH NO. EGNAD133 DATE 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris, D. Tisdell*
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: Fed X
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: *[Signature]* / NVL
 DATE: 08/07/00 TIME: 09:40 INITIALS: JP
 ANALYZED BY: *[Signature]*
 LAB Q.C. APPROVAL: *[Signature]*
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE FOR EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10093

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/00
SHEET 8 OF 8

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-845-193	B	1	Mech Room	C1A	41	BN	Ceiling Insulation - Brown Spray - ON
2 2177-845-194	B	1	Mech Room	C1A	41	BN	↓
3 2177-845-195	B	1	Mech Room	C1A	41	BN	↓
4 2177-845-196	B	1	Mech Room	C1A	41	BN	↓
5 2177-845-197	B	2		C2A	42	BO	HVAC Vibration Cloth - White Woven Material
6 2177-845-198	B	3	Bath Room	C2D	43	BP	1'x2' Acoustic Ceiling Tile, Large Pinhole Pattern
7 2177-845-199	B	3	Hallway	C2D	43	BP	↓
8 2177-845-200	B	3	Hallway	C2D	43	BP	↓
9 2177-845-	B						↓
10 2177-845-	B						
11 2177-845-	B						
12 2177-845-	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
20086147							
1146							
1149							
1150							
1151							
1152							
1153							
1154							
1155							
1156							
1157							
1158							
1159							
1160							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day Test
 JOB NO. 2177-08E BATCH NO. EKNAD1331 DATE: 8/2/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL.
 SIGNATURE: W. Harris / D. Tisdell
 TIME COMPLETED: 17:00 DELIVERED TO LAB BY: Fed Ex

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: [Signature] NM

DATE: 08/02/00 TIME: 8:40am INITIALS: JP

ANALYZED BY: [Signature]

LAB Q.C. APPROVAL: [Signature]

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

00-10465

DATE: 08/08/00
SHEET 1 OF 1

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B						
2	B						
3	B						
4	B						
5	B						
6	B						
7	B						
8	B						
9	B	1	Post Office	C1A	44	BQ	Pipe Hanger Insulation - Chilled Water
10	B	1	Post Office	C1A	45	BR	Pipe Hanger Insulation - Chilled Water
11	B	2	Med Room	C1A	46	BS	Pipe Hanger Insulation - Chilled Water
12	B	1	Med Room	Hot Water Tank	47	BT	Hot Water Tank Insulation - Top

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION								COMMENTS	
	CH	AM	CR	AC	AN	TR	TR	TR		
1										
2										
3										
4										
5										
6										
7										
8										
9	20083665									
10	3666									
11	3667									
12	3668									

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5/24/00
 JOB NO. 2177-00F BATCH NO. EKN001333 DATE: 08/08/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 16:30 DELIVERED TO LAB BY: FedEx
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AUKORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Thomas*
 DATE: 8/11/00 TIME: 8:30AM INITIALS: TS
 ANALYZED BY: *Mick Long*
 LAB Q.C. APPROVAL: *NL*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

00-10465

DATE: 03/09/00
SHEET 1 OF 1

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHORFIELD.

E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION	
BT 1	B	1	Mech Room	Hot H ₂ O Tank	47	BT	Hot Water Tank Insulation - Side	
2	B	1	Mech Room	Hot H ₂ O Tank	47	BT	Hot Water Tank Insulation - Bottom	
3	B	1	Mech Room	Hot H ₂ O Pipe	48	BU	Hot Water Pipe Insulation - Elbow	
4	B	1	Mech Room	Hot H ₂ O Pipe	48	BU	↓ ↓ ↓ ↓ ↓	
3U 5	B	2	Hallway	Chilled Water Pipe	49	BV	Pipe Hanger Insulation - Chilled Water	
3W 6	B	3	Hallway	WA2	50	BW	Wall Insulation	
7	B	3	Hallway	WD2	50	BW		
8	B	2	Hallway	WD2	50	BX		
9	B	2	Hallway	WA2	50	BX		
10	B	2	Sanitor Closet	WC2	50	BX	↓	
11	B	1	Exterior	WA1	51	BY	Window Caulking	
12	B	2	Exterior	WA1	51	BY	↓	

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
2070-3669							
3670							
3671							
3672							
3673							
3674							
3675							
3676							
3677							
3678							
3679							
3680							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT

JOB NO. 2177-00F BATCH NO. EKN491333 DATE: 08/19/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS D. TESDELL

SIGNATURE: W.H. C. Harris

TIME COMPLETED: 16:30 DELIVERED TO LAB BY: Fid Ex

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE N. SEATTLE WASHINGTON 98103

RECEIVED BY: Jerman

DATE: 8/11/00 TIME: 8:30am INITIALS: TC

ANALYZED BY: Allen

LAB Q.C. APPROVAL: AK

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

00-10465

DATE: 8/8/00
SHEET 13 OF 3

BLOC. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	3	Exterior	WA1	51	BY	Window Caulking
2	B						
3	B						
4	B						
5	B						
6	B						
7	B						
8	B						
9	B						
10	B						
11	B						
12	B						

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	ASBESTOS CONCENTRATION								COMMENTS
	CH	AM		CR	AC	AN	TR		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT

JOB NO. 2177-00F BATCH NO. EKN01333 DATE: _____

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS D. TISDELL

SIGNATURE: [Signature]

TIME COMPLETED: 17:00 DELIVERED TO LAB BY: Fed Ex

LAB NAME: NVI LABORATORIES, INC.

ADDRESS: 4788 ALDORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: [Signature]

DATE: 8/11/00 TIME: 8:30am INITIALS: TE

ANALYZED BY: [Signature]

LAB Q.C. APPROVAL: [Signature]

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076587 Client Sample #: 2177-845-001

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray vinyl tile, LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076588 Client Sample #: 2177-845-002

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray vinyl tile, LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076589 Client Sample #: 2177-845-003

Sample Location: Quad I and J, Schofield
Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
----------------	---------

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 4%

Lab ID #: 20076590 Client Sample #: 2177-845-004

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 4%

Lab ID #: 20076591 Client Sample #: 2177-845-005

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic, LAYER 3: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

LAYER 3: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Asphalt/binder, Mineral debris

LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 4%

LAYER 3: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076592 Client Sample #: 2177-845-006

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic, LAYER 3: Amber-colored mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris
LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%
LAYER 3: *None Detected	ND

Lab ID #: 20076593 Client Sample #: 2177-845-007

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic, LAYER 3: Amber-colored mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris
LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076594 Client Sample #: 2177-845-008

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic, LAYER 3: Brown mastic, LAYER 4: White cementitious material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 2%
LAYER 4: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris
LAYER 3: Adhesive/binder, Mineral debris
LAYER 4: Calcareous matrix, Mineral/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20076595 Client Sample #: 2177-845-009

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Gray vinyl tile, LAYER 2: Black mastic, LAYER 3: Amber-colored mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris
LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100

Fax: 206.634.1936

Bulk Asbestos Fiber Analysis**NVLAP**

#102063

Client: Edward K. Noda & Associates

Address: 615 Piko Street, Suite 300

Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad I and J, Schofield

NVL Batch Number: 00-09927.00

Client Project #: 09927

Number of samples: 47

Lab ID #: 20076596 Client Sample #: 2177-845-010

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Gray vinyl tile, LAYER 2: Black mastic, LAYER 3: Amber-colored mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

LAYER 3: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Asphalt/binder, Mineral debris

LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 3%

LAYER 3: *None Detected ND

Lab ID #: 20076597 Client Sample #: 2177-845-011

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Beige vinyl tile, LAYER 2: Amber-colored mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20076598 Client Sample #: 2177-845-012

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Beige vinyl tile, LAYER 2: Amber-colored mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Adhesive/binder, Mineral debris

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Date: 08/04/2000

Reviewed by: Munaf Khan

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076599 Client Sample #: 2177-845-013

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076600 Client Sample #: 2177-845-014

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Blue vinyl tile, LAYER 2: Clear mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Date: 08/04/2000

Reviewed by: Munaf Khan

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076601 Client Sample #: 2177-845-015

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Blue vinyl tile, LAYER 2: Clear mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076602 Client Sample #: 2177-845-016

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Tan vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076603 Client Sample #: 2177-845-017

Sample Location: Quad I and J, Schofield
Description: LAYER 1: White vinyl tile, LAYER 2: Black mastic, LAYER 3: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris
LAYER 3: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

LAYER 1:	*None Detected	ND
LAYER 2:	Chrysotile	3%
LAYER 3:	*None Detected	ND

Lab ID #: 20076604 Client Sample #: 2177-845-018

Sample Location: Quad I and J, Schofield
Description: White vinyl tile**OTHER FIBROUS MATERIALS:**

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Vinyl/binder, Mineral/binder

PERCENT

ND

Lab ID #: 20076605 Client Sample #: 2177-845-019

Sample Location: Quad I and J, Schofield
Description: LAYER 1: White vinyl tile, LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**ASBESTOS TYPE:**LAYER 1: *None Detected
LAYER 2: *None Detected**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris**PERCENT**ND
ND

Lab ID #: 20076606 Client Sample #: 2177-845-020

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076607 Client Sample #: 2177-845-021

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 20076608 Client Sample #: 2177-845-022

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Date: 08/04/2000

Reviewed by: Munaf Khan

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076609 Client Sample #: 2177-845-023

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076610 Client Sample #: 2177-845-024

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076611 Client Sample #: 2177-845-025

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray/green vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100

Fax: 206.634.1936

Bulk Asbestos Fiber Analysis**NVLAP**

#102063

Client: Edward K. Noda & Associates

Address: 615 Piko Street, Suite 300

Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad I and J, Schofield

NVL Batch Number: 00-09927.00

Client Project #: 09927

Number of samples: 47

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 3%

Lab ID #: 20076612 Client Sample #: 2177-845-026

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 4%

Lab ID #: 20076613 Client Sample #: 2177-845-027

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder

LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: Chrysotile 3%

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09927.00

Client Project #: 09927
Number of samples: 47

Lab ID #: 20076614 Client Sample #: 2177-845-028

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: Chrysotile 5%

Lab ID #: 20076615 Client Sample #: 2177-845-029

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: Chrysotile 4%

Lab ID #: 20076616 Client Sample #: 2177-845-030

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris**ASBESTOS TYPE: PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

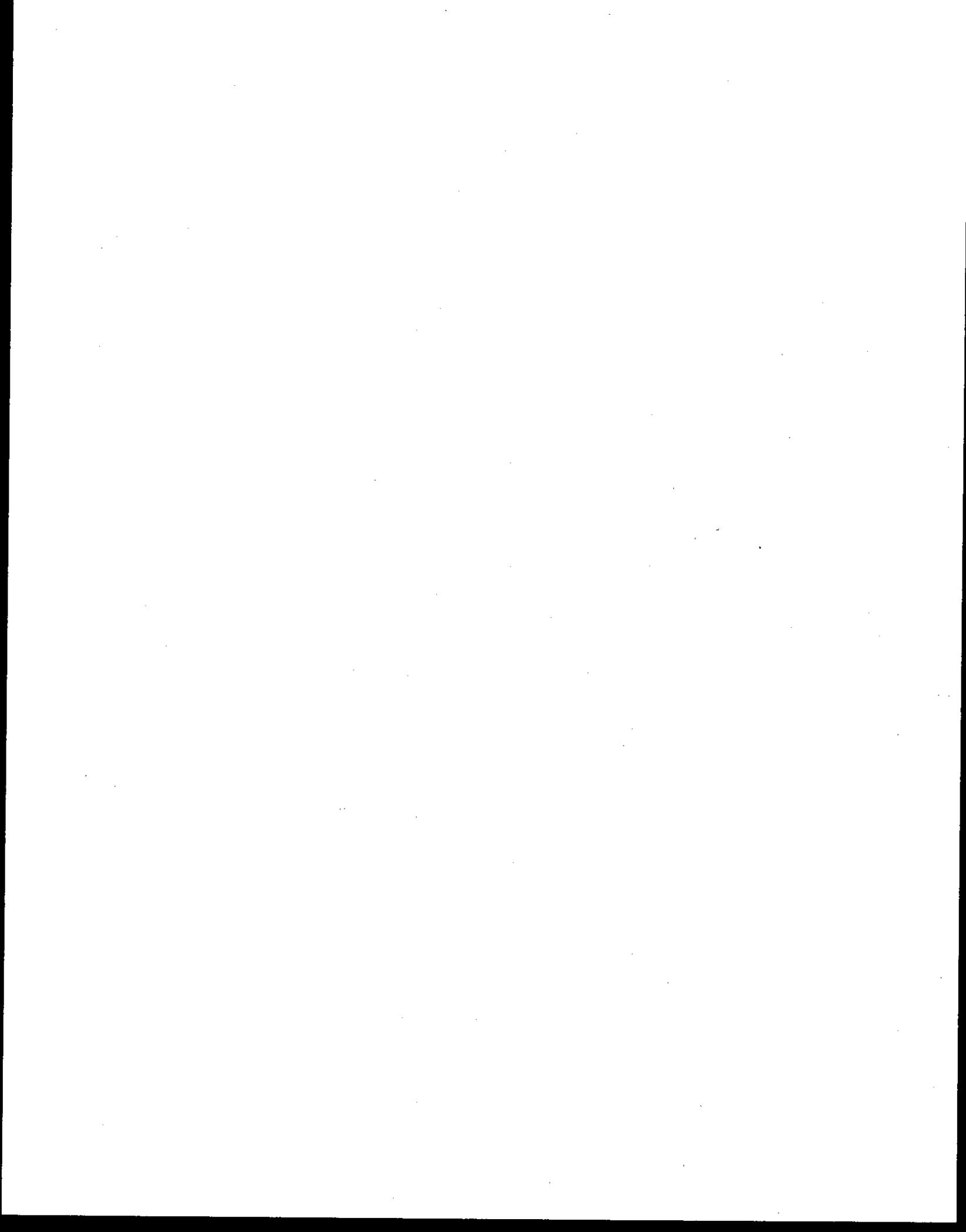
Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



APPENDIX F

BUILDING 846

I Introduction

Building 846 is a 3-story concrete structures which provides office space on the first floor, and living quarters on the second and third floors. The primary hot water heater and hot water storage tank are located on the first floor of the building. Chilled water for the air conditioning systems are supplied by a chilled water plant located in Building 845.

II TCLP Results

The TCLP result for Building 846 is below the regulated level therefore non-asbestos building debris may be disposed as general construction debris (see end of appendix for analytical results).

III Asbestos Result Summary

Materials found to contain greater than one percent (>1%) asbestos by laboratory analysis is listed below. An asterisk preceding the material description indicates the material is considered friable or potentially friable.

12" x 12" Brown Vinyl Floor Tile with **Mastic - Black**
12" x 12" Cocoa Brown Streaks Vinyl Floor Tile with **Mastic - Black**
12" x 12" Brown with Orange Streaks Vinyl Floor Tile with **Mastic**
12" x 12" Grey with Beige Marbling Vinyl Floor Tile with **Mastic - Black**
12" x 12" Olive Green Vinyl Floor Tile with **Mastic - Black**
12" x 12" Tan with Brown Streaks Vinyl Floor Tile with **Mastic - Black**
12" x 12" Blue Gray with White Marbling Vinyl Floor Tile with **Mastic - Black**
Flashing with Grey Sealant - At Roof Flues
First, Second & Third Floor Plenums
***Joint Sealant/Mastic on Fiberglass Pipe Insulation - White fine calcareous matrix**
Exterior
Transite Pipe

IV Remarks and Comments

Review "Asbestos Survey, Analytical and Report for: Buildings T-754, T-756, T-758, T-759, 845 and 846 - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

V Survey Findings

EKNAs inspectors, William Harris and Douglas Tisdell identified forty nine (49) distinct material types and submitted two hundred and twelve (212) suspect samples for laboratory analysis. Material types sampled are listed on the following two (2) pages. Materials found to contain >1% asbestos are indicated in bold print (an asterisk indicates a friable material).

12" x 12" Brown Vinyl Floor Tile with **Mastic - Black**
 12" x 12" Cocoa Brown Streaks Vinyl Floor Tile with **Mastic - Black**
 12" x 12" Brown with Orange Streaks Vinyl Floor Tile with **Mastic - Black**
 12" x 12" Grey with Beige Marbling Vinyl Floor Tile with **Mastic - Black**
 12" x 12" Dark Grey Vinyl Floor Tile with Mastic
 12" x 12" Beige with Tan, Brown Streaks Vinyl Floor Tile with Mastic
 12" x 12" Olive Green Vinyl Floor Tile with **Mastic - Black**
 12" x 12" Tan with Brown Streaks Vinyl Floor Tile with **Mastic - Black**
 12" x 12" White with Brown Streaks Vinyl Floor Tile with Mastic
 12" x 12" Green with White Streaks Vinyl Floor Tile with Mastic
 12" x 12" Off White with Black Streaks Vinyl Floor Tile with Mastic
 12" x 12" Light Grey with White Marbling Vinyl Floor Tile with Mastic
 12" x 12" Blue Gray with White Marbling Vinyl Floor Tile with **Mastic - Black**
 4" Brown Cove Base with Adhesive
 4" Pink Cove Base with Adhesive (Brown Cove Base Painted Pink)
 4" Black Cove Base with Adhesive
 Cove Base with Adhesive
 Gypsum Board with Joint Compound
 Plaster with Skim Coat
 2' x 4' Acoustical Ceiling Tile, Fissure
 2' x 4' Acoustical Ceiling Tile, Random Pattern
 2' x 4' Acoustical Ceiling Tile, Small Fissure Pattern
 2' x 4' Acoustical Ceiling Tile, Pinhole Pattern
 Composition Roll Roofing Material - Primary Roofing
Flashing with Grey Sealant - At Roof Flues
 Grey Sealant at Roof Vents
 Flashing with Grey Sealant - At Access Hatch
 Composition Roofing Material - Roll Roofing - Southernmost Roof Shed
 Composition Roofing Material - Roll Roofing - Southern Walkway Roof
 Composition Roofing Material - Roll Roofing - Central Shed Roof
 Composition Roofing Material - Roll Roofing - Northern Walkway
 Composition Roofing Material - Roll Roofing - Northernmost Shed Roof
 Asphaltic Barrier Paper Behind Plaster Wall
 Wall Insulation

First Floor Plenum

Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White fine calcareous matrix

Heater, Ventilation Air Conditioning (HVAC) Vibration Cloth
 HVAC Duct Insulation
 Internal Duct Insulation
 Pipe/Wall Sealant with Paper

Second Floor Plenum

*Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White fine calcareous matrix*

HVAC Vibration Cloth

HVAC Duct Insulation

Third Floor Plenum

*Joint Sealant/Mastic on Fiberglass Pipe Insulation - *White fine calcareous matrix*

HVAC Vibration Cloth

HVAC Duct Insulation

Internal Duct Insulation

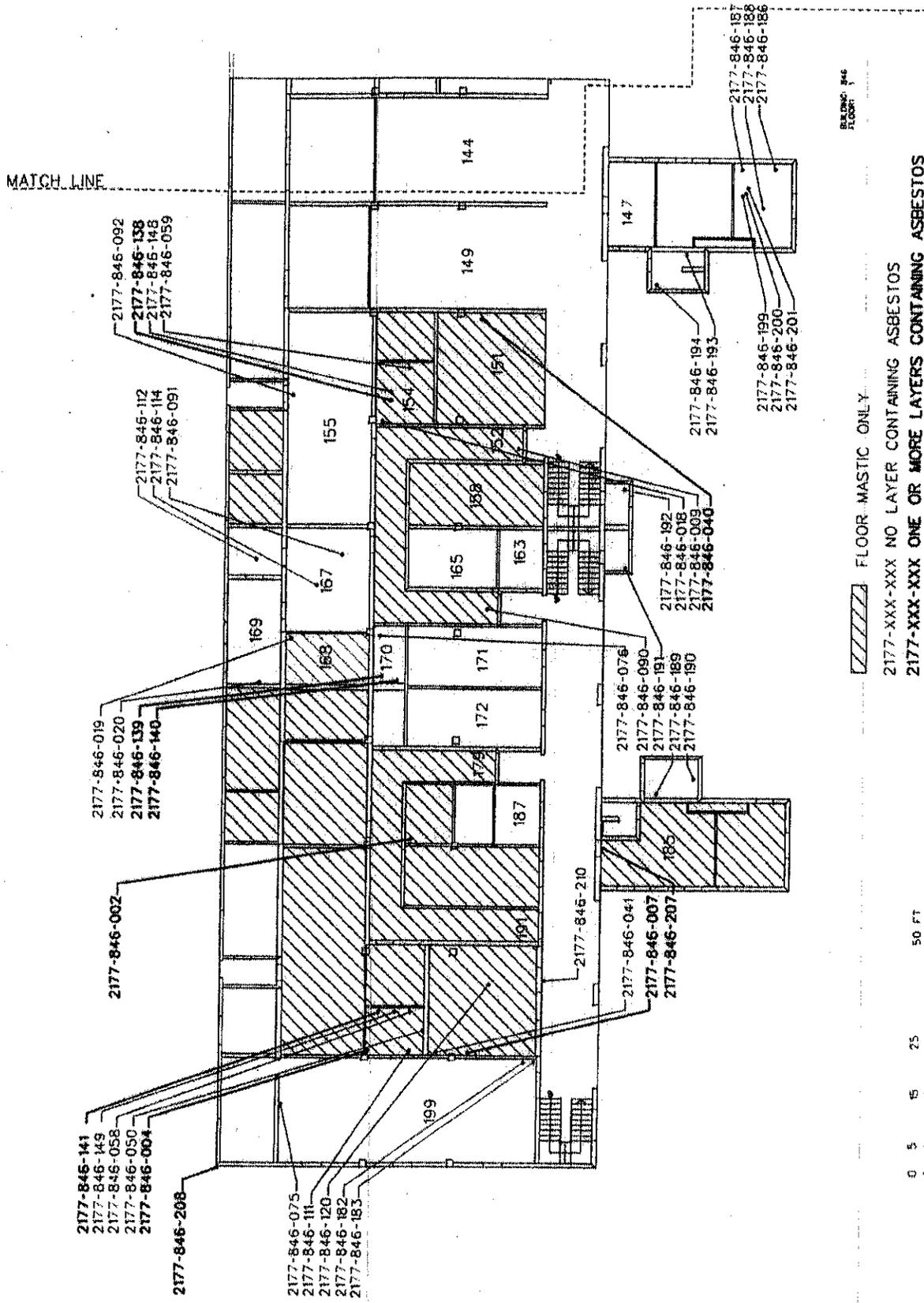
First Floor Machine Room

Joint Sealant/Mastic on Fiberglass Pipe Insulation

Hot Water Tank Insulation

Exterior

Transite Pipe



BEARING 846 FLOOR

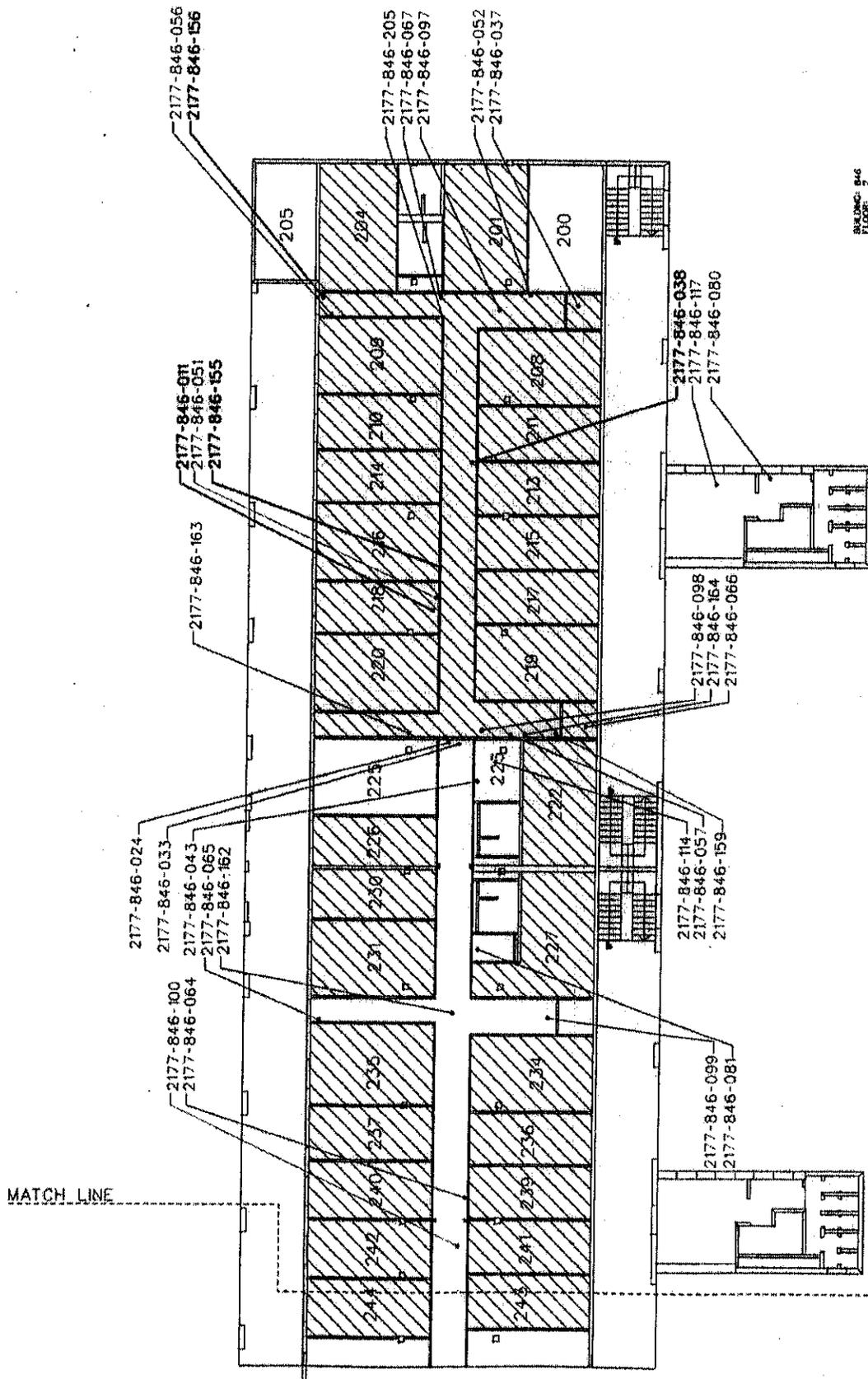
- ▨ FLOOR MASTIC ONLY
- 2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
- 2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS
- MISSING SAMPLE LOCATIONS (29, 30, 181)



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 846

FIGURE
F-3



2177-846-038
2177-846-117
2177-846-080

/// FLOOR MASTIC ONLY

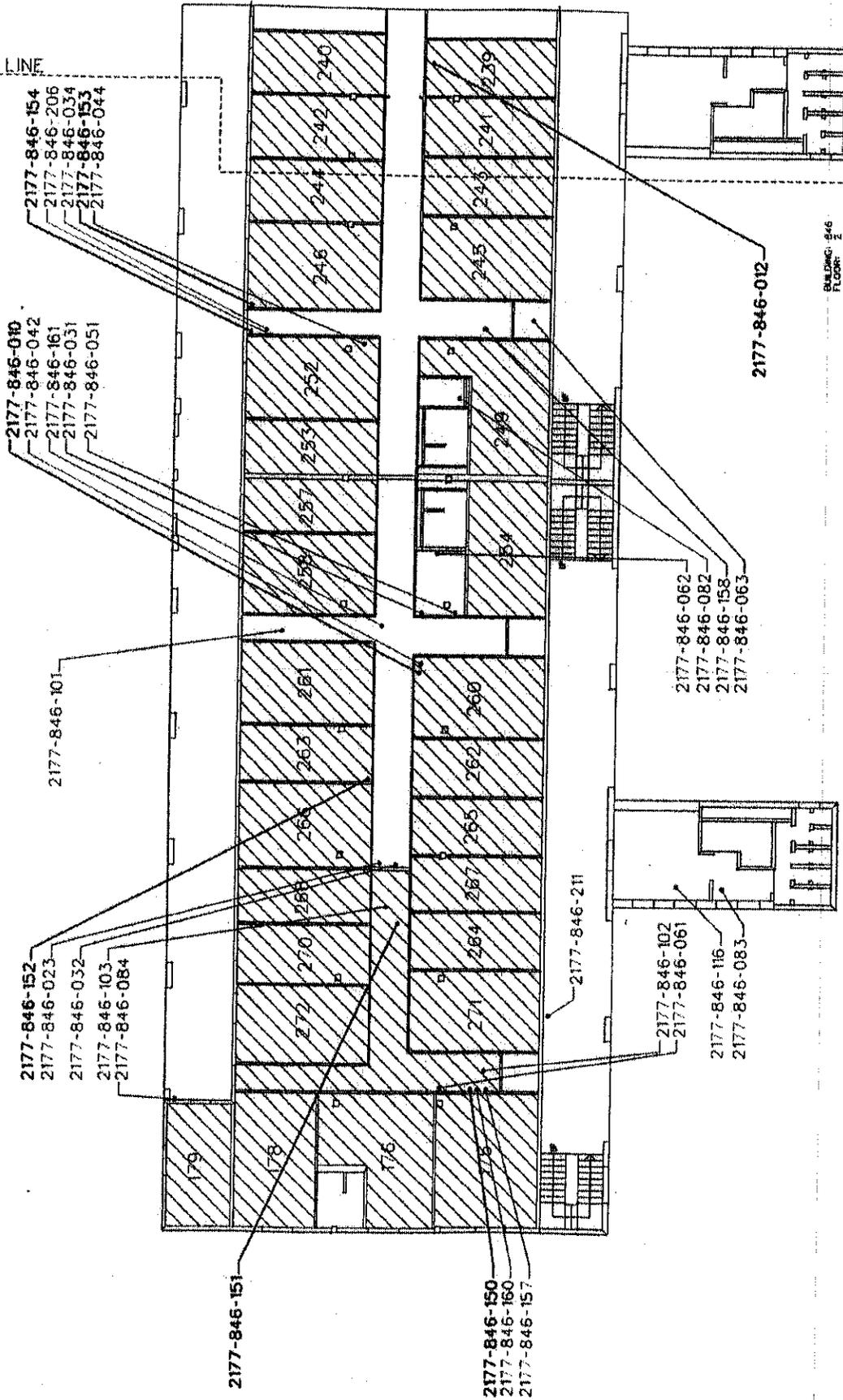
2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

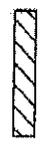
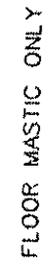
The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA83-00-D-0007, I.O. 0003

Sample Location Plan
Building 846

FIGURE
F-4

MATCH LINE



 FLOOR MASTIC ONLY
 2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
 2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

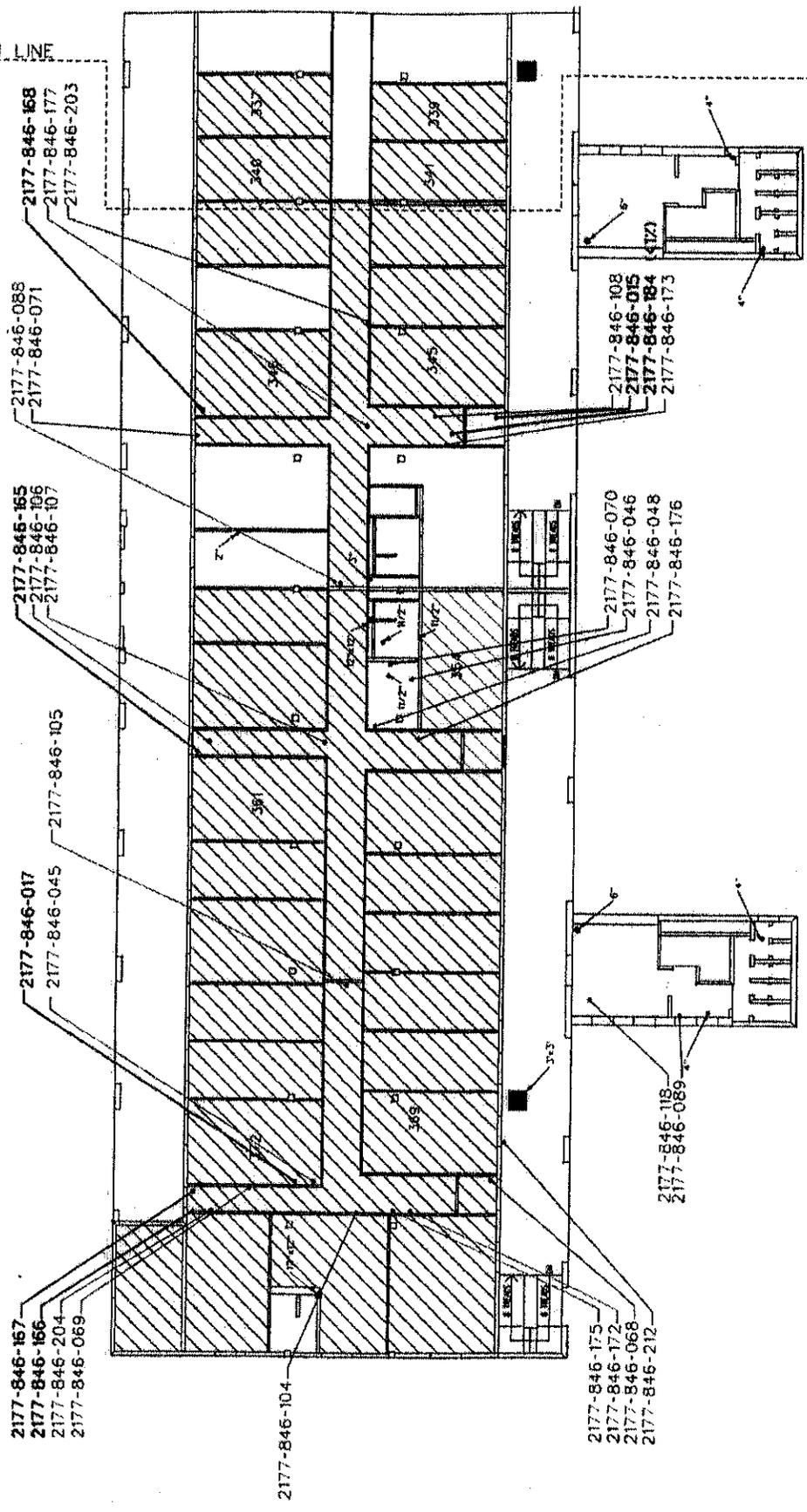


The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0087, T.O. 0003

Sample Location Plan
 Building 846

FIGURE
F-5

MATCH LINE



2177-846-167
 2177-846-166
 2177-846-204
 2177-846-069

2177-846-155
 2177-846-196
 2177-846-107

2177-846-088
 2177-846-071

2177-846-017
 2177-846-045

2177-846-168
 2177-846-177
 2177-846-203

2177-846-175
 2177-846-172
 2177-846-068
 2177-846-212

2177-846-118
 2177-846-089

2177-846-108
 2177-846-015
 2177-846-184
 2177-846-173

BUILDING 846
 FLOOR 3

▨ FLOOR MASTIC ONLY

2177-XXX-XXX NO LAYER CONTAINING ASBESTOS

2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS

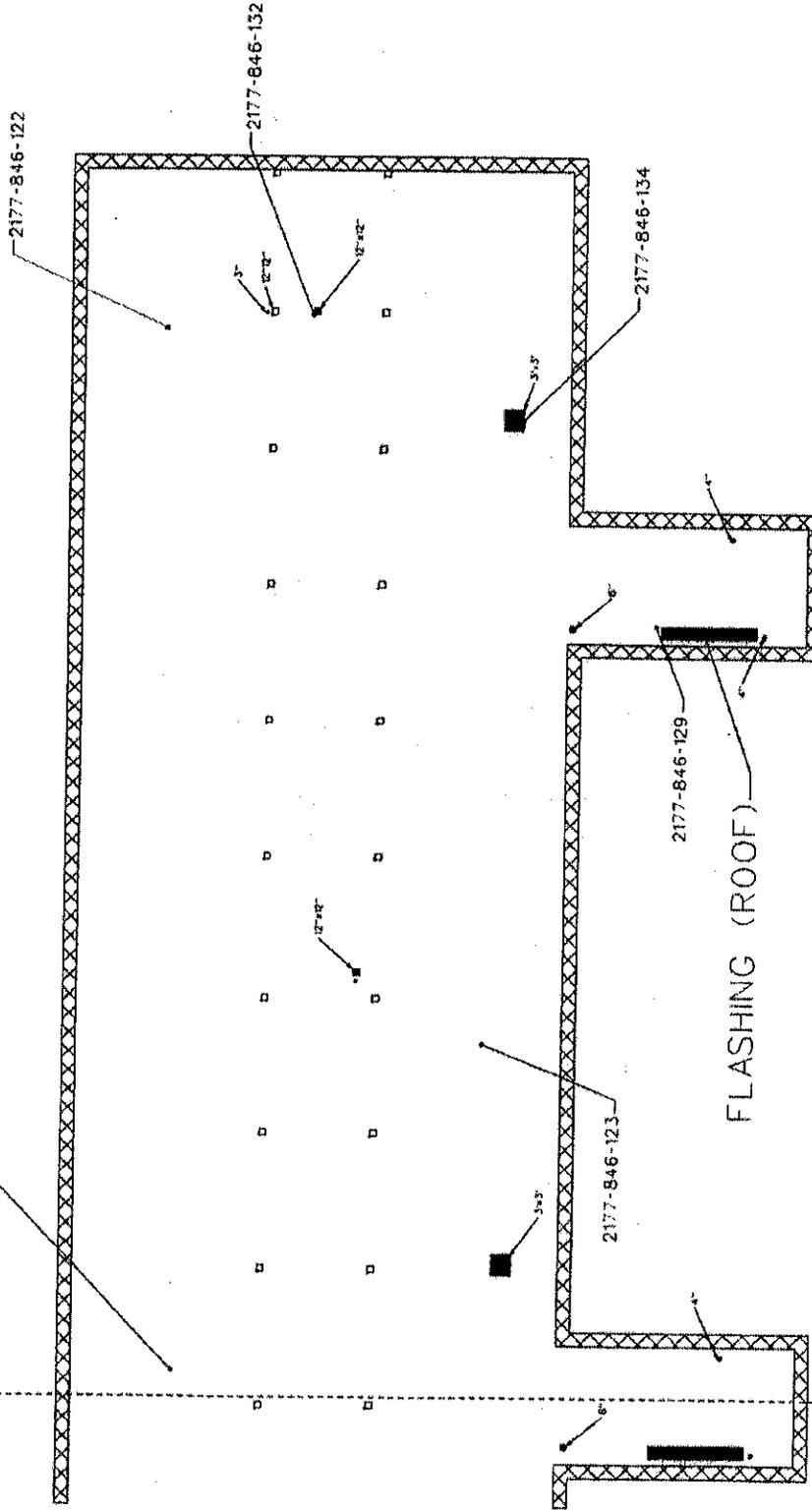


The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

FIGURE
 F-7

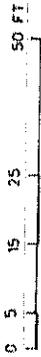
MATCH LINE

2177-846-124



BUILDING: 846
FLOOR: 3

 2' WIDE TRANSITE EAVE PANELS (ASSUMED - NO SAMPLES COLLECTED)
 2177-XXX-XXX NO LAYER CONTAINING ASBESTOS



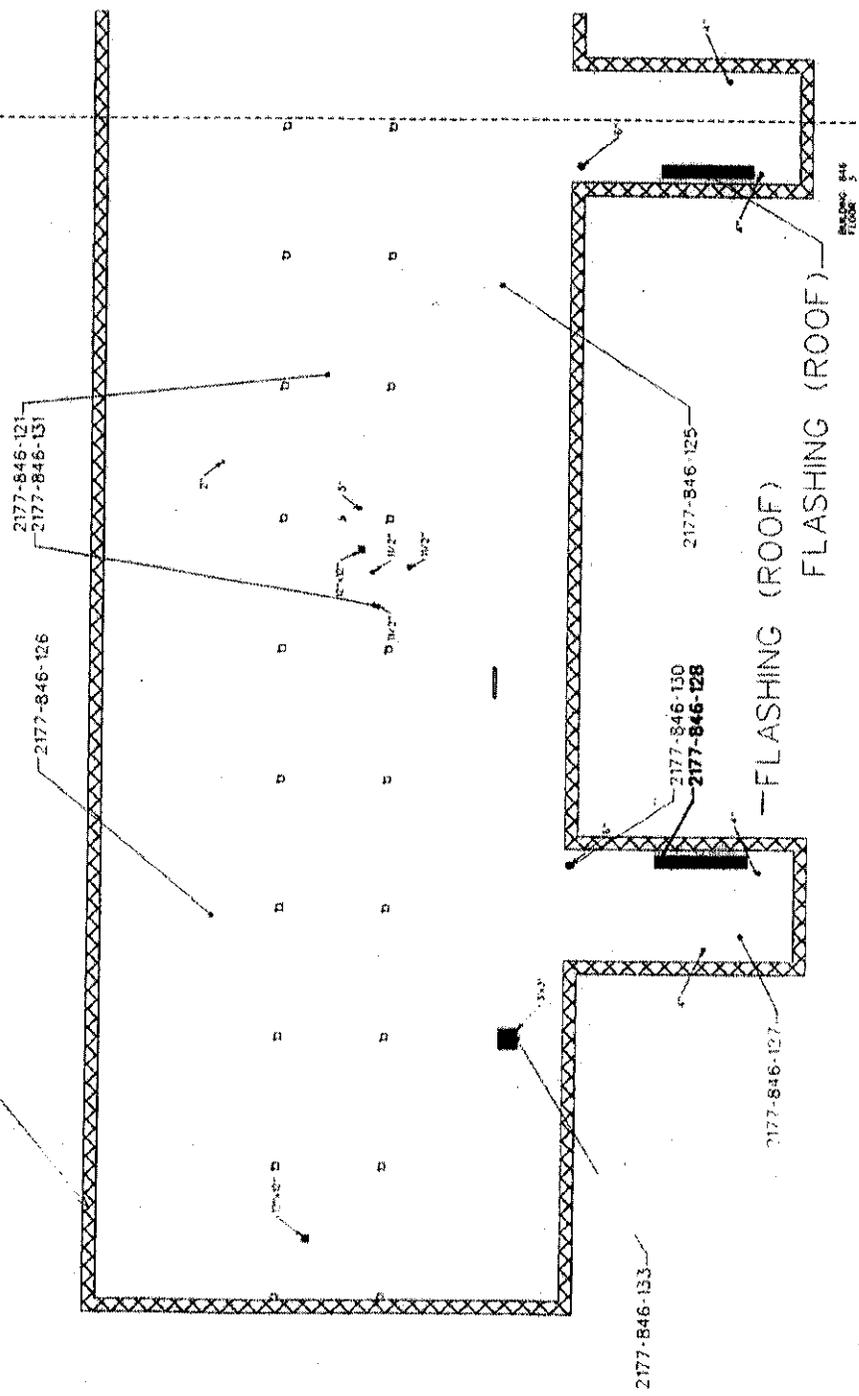
The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 846

FIGURE
F-8

MATCH LINE

2' WIDE TRANSITE EAVE PANELS (ASSUMED - NO SAMPLES COLLECTED)



2' WIDE TRANSITE EAVE PANELS (ASSUMED - NO SAMPLES COLLECTED)
 2177-XXX-XXX NO LAYER CONTAINING ASBESTOS
2177-XXX-XXX ONE OR MORE LAYERS CONTAINING ASBESTOS



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0907, T.O. 0003

Sample Location Plan
 Building 846

FIGURE
F-9

00-09929

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAMES:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 1 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846-001	1	105	F1A	1	A	12" x 12" Vinyl Floor Tile (Brown) with Mastic
2 2177-846-002	1	189	F1A	1	A	" " " "
3 2177-846-003	1	101	F1A	2	B	12" x 12" Cocoa Brown Vinyl Floor Tile with Mastic
4 2177-846-004	1	199	F1A	2	B	" " " "
5 2177-846-005	1	132	F1A	3	C	12" x 12" Brown w/ Orange Strakes Vinyl Floor Tile with Mastic
6 2177-846-006	1	140	F1A	3	C	" " " "
7 2177-846-007	1	195	F1A	3	C	" " " "
8 2177-846-008	1	131	F1A	4	D	12" x 12" Grey w/ Beige Marbling Vinyl Floor Tile with Mastic
9 2177-846-009	1	162	F1A	4	D	" " " "
10 2177-846-010	2	260	F1A	4	E	" " " "
11 2177-846-011	2	218	F1A	4	E	" " " "
12 2177-846-012	2	239	F1A	4	E	" " " "

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION					
	CH	AM	CR	AC	AN	TR
1 20076701						
2 6702						
3 6703						
4 6704						
5 6705						
6 6706						
7 6707						
8 6708						
9 6709						
10 6710						
11 6711						
12 6712						

COMMENTS: FAXED 8/2

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day 747
 JOB NO. 2177-00F BATCH NO. EKN601333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NTL LABORATORIES, INC.
 ADDRESS: 1728 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Thao Do* TIME: 10:45 INITIALS:
 ANALYZED BY: *SZ*
 LAB Q.C. APPROVAL: *AK*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
 SHEET 2 OF 10
 E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION	ANALYTICAL LABORATORY RESULTS			
								CH	AM	CR	AC
1	B	3	317	F1A	4	F	12" x 12" Grey w/ Beige Marble Vinyl Floor Tile with Mastic				
2	B	3	Hallway	F1A	4	F					
3	B	3	Hallway	F1A	4	F					
4	B	3	Hallway	F1A	4	F					
5	B	3	Hallway	F1A	4	F					
6	B	3	372	F1A	4	F					
7	B	1	154	F1A	5	G	12" x 12" Dark Grey Vinyl Floor Tile with Mastic				
8	B	1	168	F1A	5	G					
9	B	1	169	F1A	6	H	12" x 12" Beige w/ Tan, Brown Streaks Vinyl Floor Tile with Mastic				
10	B	1	143	F1A	7	I					
11	B	1	120	F2A	7	I	12" x 12" Olive Green Vinyl Floor Tile with Mastic				
12	B	2	Hallway	F2A	7	I					
	B	2	Hallway	F2A	7	J					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 2177-00F BATCH NO. EKN08333 DATE: 07/28/00
 CLIENT NAME: FLING ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: [Signature]
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL

LAB NAME: NYL LABORATORIES, INC.
 ADDRESS: 4700 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10:45 INITIALS: [Initials]
 ANALYZED BY: SSZ
 LAB Q.C. APPROVAL: [Signature]
 PROJECT MANAGERS APPROVAL: [Signature]

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: _____

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

DATE: 07/19/00
SHEET 3 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1	B	3	Hallway	F2A	7	K	12" x 12" Olive Green Vinyl Floor Tile with Mastic
2	B	1	102	F1A	8	L	12" x 12" Tan w/ Brown Streak Vinyl Floor Tile with Mastic
3	B	1	120	F1A	8	L	
4	B	1	114	F1A	8	L	
5	B	1	Restroom	F1A	9	M	12" x 12" White w/ Brown Streak Vinyl Floor Tile with Mastic
6	B	1	181	F1A	10	N	12" x 12" Green w/ White Streak Vinyl Floor Tile with Mastic
7	B	2	Mech Room	F1A	10	O	
8	B	2	Hallway	F1A	11	P	12" x 12" OFF White w/ Black Streak Vinyl Floor Tile with Mastic
9	B	2	Hallway	F1A	11	P	
10	B	2	Hallway	F1A	11	P	
11	B	3	Hallway	F1A	12	Q	12" x 12" Light Grey w/ White Marble Vinyl Floor Tile with Mastic
12	B	3	Hallway	F1A	12	Q	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CB	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT

JOB NO. 2177-006 BATCH NO. EKN401333 DATE: 07/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: [Signature] DELIVERED TO LAB BY: DHL

TIME COMPLETED: 12:00

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: [Signature]

DATE: 7/31/00 TIME: 10AM INITIALS: _____

ANALYZED BY: SR

LAB Q.C. APPROVAL: ML

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 5 OF 10

E-MAIL DATA: YES NO X

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	1	105	WPI	16	W	4" Black Cove Base with Adhesive
2	B	1	199	WCI	16	W	
3	B	2	218	WCI	16	X	
4	B	2	Hallway	WBI	17	AA	Cove Base Adhesive
5	B	3	308	WBI	16	Y	4" Black Cove Base with Adhesive
6	B	3	315	WAI	16	Y	
7	B	1	143	WCI	17	Z	Cove Base Adhesive
8	B	2	Hallway	WPI	17	AA	
9	B	2	Hallway	WPI	17	AA	
10	B	1	Baggage	WBI	18	AB	Gypsum Board with Joint Compound
11	B	1	154	WBI	18	AB	
12	B	1	101	WPI	18	AB	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CF	AM	CR	AC	AN	TR	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Aug 7 AT

JOB NO. 2177-00F BATCH NO. EKNAG1333 DATE 07/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: [Signature]

TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: Thao Do

DATE: 7/31/00 TIME: 10 AM INITIALS:

ANALYZED BY: SE

LAB O.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/29/00
SHEET 5 OF 10

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
2177-846-049	B	1	105	WD1	16	W	4" Black Cove Base with Adhesive
2177-846-050	B	1	199	WC1	16	W	
2177-846-051	B	2	218	WC1	16	X	
2177-846-052	B	2	Hallway	WB1	17	AA	Cove Base Adhesive
2177-846-053	B	3	308	WB1	16	Y	4" Black Cove Base with Adhesive
2177-846-054	B	3	315	WA1	16	Y	
2177-846-055	B	1	143	WC1	17	Z	Cove Base Adhesive
2177-846-056	B	2	Hallway	WD1	17	AA	
2177-846-057	B	2	Hallway	WD1	17	AA	
2177-846-058	B	1	Asbestos Baggage	WB1	18	AB	Gypsum Board with Joint Compound
2177-846-059	B	1	154	WB1	18	AB	
2177-846-060	B	1	101	WD1	18	AB	

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Aug 7 AT

JOB NO. 217-50E BATCH NO. ESN-48133 DATE: 07/29/00

CLIENT NAME: FLING ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISELL

SIGNATURE: *W. Harris*

TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHC

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: Thao Do

DATE: 8/31/00 TIME: 10 AM INITIALS:

ANALYZED BY: *WJL*

LAB Q.C. APPROVAL: *AK*

PROJECT MANAGERS APPROVAL:

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CR	AM	CR	AC	AN	TR	
2177-846-049							
20076756							
6757							
6758							
6759							
6760							

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	2	Hallway	WD1	18	AC	Gypsum Board with Joint Compound
2	B	2	Mech. Room	WB1	18	AC	
3	B	2	Hallway Entry	C1A	18	AC	
4	B	2	Hallway	WC1	18	AC	
5	B	2	Hallway	WD1	18	AC	
6	B	2	Hallway Entry	C1A	18	AC	
7	B	2	Hallway	WB1	18	AC	
8	B	3	Hallway Entry	C1A	18	AD	
9	B	3	Hallway	WB1	18	AD	
10	B	3	Mech. Room	WB1	18	AD	
11	B	3	Hallway	WD1	18	AD	
12	B	3	Hallway	WA1	18	AD	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
20076761							
6762							
6763							
6764							
6765							
6766							
6767							
6768							
6769							
6770							
6771							
6772							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day JAT

JOB NO. 217206F BATCH NO. EKN40133 DATE: 02/28/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: [Signature]

TIME COMPLETED: 12:00 DELIVERED TO LAB BY: PHC

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: Thao Do

DATE: 2/3/00 TIME: 10 AM INITIALS: _____

ANALYZED BY: WL

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
SHEET 7 OF 10

E-MAIL DATA: YES NO X

BLDG. AND PROJECT NAME: **ASBESTOS & LEAD SURVEY; QUAD I and J, SCHORFIELD.**

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846-073	B	3	Hallway Entry	C1A	18	AD	Gypsum Board with Joint Compound
2 2177-846-074	B	3	Hallway	WD1	18	AD	↓
3 2177-846-075	B	1	199	WAI	19	AE	Plaster with SKim Coat
4 2177-846-076	B	1	170	WAI	19	AE	
5 2177-846-077	B	1	128	WAI	19	AE	
6 2177-846-078	B	1	Exterior	WB1	19	AE	
7 2177-846-079	B	1	BN-34	WAI	19	AE	
8 2177-846-080	B	2	Mens Lounge	WB1	19	AF	
9 2177-846-081	B	2	Transfer Closet	WAI	19	AF	
10 2177-846-082	B	2	Transfer Closet	WC1	19	AF	
11 2177-846-083	B	2	Mens Lounge	WD1	19	AF	
12 2177-846-084	B	2	Exterior	WAI	19	AF	↓

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS	ACCOUNTABILITY RECORD
	CH	AM	CR	AC		
1 20076773						REQUESTED COMPLETION DATE: <u>5 day TAT</u> JOB NO. 2177-09F BATCH NO. EKN00333 DATE: <u>07/28/00</u> CLIENT NAME: FUNG ASSOCIATES SAMPLERS NAME: W. HARRIS, D. TISDELL SIGNATURE: <u>[Signature]</u> TIME COMPLETED: <u>12:00</u> DELIVERED TO LAB BY: <u>DHL</u> LAB NAME: NVL LABORATORIES, INC. ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103 RECEIVED BY: <u>Thao Do</u> DATE: <u>7/31/00</u> TIME: <u>10 AM</u> INITIALS: <u>[Initials]</u> ANALYZED BY: <u>[Signature]</u> LAB O.C. APPROVAL: <u>[Signature]</u> PROJECT MANAGERS APPROVAL: _____
2 6774						
3 6775						
4 6776						
5 6777						
6 6778						
7 6779						
8 6780						
9 6781						
10 6782						
11 6783						
12 6784						

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 07/28/00
 SHEET 8 OF 10

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD. E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	3	men's Cathrine	WB1	19	AG	Plaster with SKIM Coat
2	B	3	Exterior	WA1	19	AG	
3	B	3	Hallway	WD1	19	AG	
4	B	3	Hallway	WD1	19	AG	
5	B	3	Cathrine	WD1	19	AG	
6	B	1	162	CIA	20	AH	2'x4' Acoustic Ceiling Tile, Fissure Pattern
7	B	1	167	CIA	20	AH	
8	B	1	155	CIA	20	AH	
9	B	1	137	CIA	20	AH	
10	B	1	125	CIA	20	AH	
11	B	1	114	CIA	20	AH	
12	B	1	119	CIA	20	AH	

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 day TAT
 JOB NO. 217-08F BATCH NO. ERNAB133 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: [Signature]
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL

LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: Thao Do
 DATE: 7/31/00 TIME: 10 AM INITIALS:
 ANALYZED BY: GL
 LAB Q.C. APPROVAL: AK
 PROJECT MANAGERS APPROVAL:

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AH	CR	AC	AR	TR	
1	20076785						
2	6786						
3	6787						
4	6788						
5	6789						
6	6790						
7	6791						
8	6792						
9	6793						
10	6794						
11	6795						
12	6796						

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 9 OF 10

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846-097	B	2	Hallway	C1A	20	AI	2'x4' Acoustic Ceiling Tile, Fissure Pattern
2 2177-846-098	B	2	Hallway	C1A	20	AI	
3 2177-846-099	B	2	Hallway	C1A	20	AI	
4 2177-846-100	B	2	Hallway	C1A	20	AI	
5 2177-846-101	B	2	Hallway	C1A	20	AI	
6 2177-846-102	B	2	Hallway	C1A	20	AI	
7 2177-846-103	B	2	Hallway	C1A	20	AI	
8 2177-846-104	B	3	Hallway	C1A	20	AJ	
9 2177-846-105	B	3	Hallway	C1A	20	AJ	
10 2177-846-106	B	3	Hallway	C1A	20	AJ	
11 2177-846-107	B	3	Hallway	C1A	20	AJ	
12 2177-846-108	B	3	Hallway	C1A	20	AJ	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 20076797					
2 6798					
3 6799					
4 6800					
5 6801					
6 6802					
7 6803					
8 6804					
9 6805					
10 6806					
11 6807					
12 6808					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-00F BATCH NO. EKNAB1333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris*
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHL
 LAB NAME: NYL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98107
 RECEIVED BY: *Paul De*
 DATE: 7/31/00 TIME: 10 AM INITIALS: *UM*
 ANALYZED BY: *AK*
 LAB Q.C. APPROVAL: *AK*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-09930

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 07/28/00
SHEET 28 OF 70

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREA/ROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION	
1	B	3	Hallway	C1A	20	AJ	2'x4'	Acoustic Ceiling Tile, Fissure Pattern
2	B	3	Hallway	C1A	20	AJ		
3	B	1	Asbestos Storage	C1A	21	AK	2'x4'	Acoustic Ceiling Tile, Random Pattern
4	B	1	170	C1A	21	AK		
5	B	1	121	C1A	21	AK		
6	B	2	233	C1A	21	AK		
7	B	3	Exec. Room	C1A	21	AM		
8	B	2	Men's Latrine	C1A	22	AN	2'x4'	Acoustic Ceiling Tile, Small Fissure Pattern
9	B	2	Men's Latrine	C1A	22	AN		
10	B	3	Men's Latrine	C1A	22	AO		
11	B	3	Men's Latrine	C1A	22	AO		
12	B	1	195	C1B	23	AP	2'x4'	Acoustic Ceiling Tile, Pinhole Pattern

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day 1HT
 JOB NO. 2177-00F BATCH NO. ENM01333 DATE: 07/28/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris* / *D. Tisdell*
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: DHC
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *Thao Do*
 DATE: 7/31/00 TIME: 10 AM INITIALS:
 ANALYZED BY: *WL*
 LAB Q.C. APPROVAL: *NL*
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

68

00-10319

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: _____

ASBESTOS & LEAD SURVEY: QUAD I and J, SCHOFIELD.

DATE SHEET: 8/2/00 OF 3

E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846-121	B	R	Roof	RIA	24	AQ	Composition Roll Roofing Material - Primary Roofing
2 2177-846-122	B	R	Roof	RIA	24	AR	
3 2177-846-123	B	R	Roof	RIA	24	AQ	
4 2177-846-124	B	R	Roof	RIA	24	AQ	
5 2177-846-125	B	R	Roof	RIA	24	AQ	
6 2177-846-126	B	R	Roof	RIA	24	AQ	
7 2177-846-127	B	R	Roof	RIA	24	AQ	
8 2177-846-128	B	R	Roof	RIB	25	AE	Flashing w/ Grey Sealant - At Roof Flue's
9 2177-846-129	B	R	Roof	RIB	25	AR	
10 2177-846-130	B	R	Roof	RIC	26	AS	Grey Sealant at Roof Vents
11 2177-846-131	B	R	Roof	RIC	26	AS	
12 2177-846-132	B	R	Roof	RIC	26	AS	

ANALYTICAL LABORATORY RESULTS											
LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS				
	CH	AM	CK	AC	AN	TR					
1 20082837							<p>REQUESTED COMPLETION DATE: <u>5 DAY TAT</u></p> <p>JOB NO. 2177-40F BATCH NO. EKNAB333 DATE: <u>8/2/00</u></p> <p>CLIENT NAME: FUNG ASSOCIATES</p> <p>SAMPLERS NAME: W. HARRIS, D. TISDELL</p> <p>SIGNATURE: <u>[Signature]</u></p> <p>TIME COMPLETED: <u>17:00</u> DELIVERED TO LAB BY: <u>FEDX</u></p> <p>LAB NAME: NVE LABORATORIES, INC.</p> <p>ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103</p> <p>RECEIVED BY: <u>[Signature]</u></p> <p>DATE: <u>08/04/00</u> TIME: <u>5:40</u> INITIALS: <u>JSP</u></p> <p>ANALYZED BY: _____</p> <p>LAB Q.C. APPROVAL: _____</p> <p>PROJECT MANAGERS APPROVAL: _____</p>				
2 2838											
3 2839											
4 2840											
5 2841											
6 2842											
7 2843											
8 2844											
9 2845											
10 2846											
11 2847											
12 2848											

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10317

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 8/2/02
SHEET 3 OF 3

E-MAIL DATA: YES NO

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-846-145	B	1	Plenum	C2C	30	AW	HVAC Duct Insulation
2 2177-846-146	B	1	Plenum	C2C	30	AW	
3 2177-846-147	B	1	Plenum	C2C	30	AW	
4 2177-846-148	B	1	Plenum	C2C	30	AW	
5 2177-846-149	B	1	Plenum	C2C	30	AW	
6 2177-846-150	B	2	Plenum	C2A	31	AX	Joint Sealant/Mastic on Fiberglass Pipe Insulation
7 2177-846-151	B	2	Plenum	C2A	31	AX	
8 2177-846-152	B	2	Plenum	C2A	31	AX	
9 2177-846-153	B	2	Plenum	C2A	31	AX	
10 2177-846-154	B	2	Plenum	C2A	31	AX	
11 2177-846-155	B	2	Plenum	C2A	31	AX	
12 2177-846-156	B	2	Plenum	C2A	31	AX	

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION						COMMENTS
	CH	AM	CR	AC	AN	TR	
1 2008 2861							
2 2862							
3 2863							
4 2864							
5 2865							
6 2866							
7 2867							
8 2868							
9 2869							
10 2870							
11 2871							
12 2872							

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 2177-90F BATCH NO. EKNAD1333 DATE: 8/2/02
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *[Signature]*
 TIME COMPLETED: 17.00 DELIVERED TO LAB BY: *[Signature]*

LAB NAME: NVE LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103

RECEIVED BY: *[Signature]* INVL
 DATE: 08/21/02 TIME: 2:00am INITIALS: JP

ANALYZED BY:

LAB O.C. APPROVAL:

PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A,B,C,AA,BB,CC)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10319

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 8/21/00
SHEET 4 OF 5

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	2	Plenum	C2B	32	AY	HVAC Vibrations Cloth
2	B	2	Plenum	C2B	32	AY	↓
3	B	2	Plenum	C2B	32	AY	↓
4	B	2	Plenum	C2C	33	AZ	HVAC Duct Insulation
5	B	2	Plenum	C2C	33	AZ	↓
6	B	3	Plenum	C2C	33	AZ	↓
7	B	2	Plenum	C2C	33	AZ	↓
8	B	2	Plenum	C2C	34	AZ	↓
9	B	3	Plenum	C2A	35	BA	Joint Sealant/Mastic on Fiberglass Pipe Insulation
10	B	3	Plenum	C2A	35	BA	↓
11	B	3	Plenum	C2A	35	BA	↓
12	B	3	Plenum	C2A	35	BA	↓

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION								COMMENTS
	CH	AM	CR	AC	AN	TR	TR	TR	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 217200F BATCH NO. ESN40133 DATE: 8/21/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS D. TISDELL
 SIGNATURE: *W. C. Harris* DELIVERED TO LAB BY: *Fed X*
 TIME COMPLETED: 17:00
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98107
 RECEIVED BY: *Debra Coon* NVL
 DATE: 08/21/00 TIME: 3:00 PM INITIALS: JCP
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC.)

00-10319

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 8/2/00
SHEET 5 OF 5

BLDG. AND PROJECT NAME:

E-MAIL DATA: YES NO

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	FLOOR NO.	TYPE	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846-169	3	B	Pleenum	C2A	35	BA	Joint Sealant/Mastic on Fiberglass Pipe Insulation
2 2177-846-170	3	B	Pleenum	C2A	35	BA	
3 2177-846-171	3	B	Pleenum	C2A	35	BA	
4 2177-846-172	3	B	Pleenum	C2B	36	BB	HVAC Vibration Cloth
5 2177-846-173	3	B	Pleenum	C2B	36	BB	
6 2177-846-174	3	B	Pleenum	C2B	36	BB	
7 2177-846-175	3	B	Pleenum	C2C	37	BC	HVAC Duct Insulation
8 2177-846-176	3	B	Pleenum	C2C	37	BC	
9 2177-846-177	3	B	Pleenum	C2C	37	BC	
10 2177-846-178	3	B	Pleenum	C2C	37	BC	
11 2177-846-179	3	B	Pleenum	C2C	37	BC	
12 2177-846-180	1	B	OFFICE	WA2	38	BD	Vapor Barrier Paper Behind Plaster

ANALYTICAL LABORATORY RESULTS

ACCOUNTABILITY RECORD

LAB ID NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 20082885					
2 2886					
3 2887					
4 2888					
5 2889					
6 2890					
7 2891					
8 2892					
9 2893					
10 2894					
11 2895					
12 2896					

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 2177-00F BATCH NO. E00A01333 DATE: 8-2-00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *W. Harris* / *D. Tisdell*
 TIME COMPLETED: 12:00 DELIVERED TO LAB BY: *Fid X*
 LAB NAME: NVL LABORATORIES INC
 ADDRESS: 4708 AURORA AVE. N. SEATTLE WASHINGTON 98103
 RECEIVED BY: *[Signature]*
 DATE: 08/02/00 TIME: 08:00 AM INITIALS: *MM*
 ANALYZED BY:
 LAB Q.C. APPROVAL:
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

00-10319

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and I, SCHOFIELD.

DATE: 8/4/00
SHEET 1 OF 1
E-MAIL DATA: YES NO

SAMPLE ID NO.	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 217-846-181	1	Plenum	CAD	39	BE	Internal Duct Insulation
2 217-846-182	1	Plenum	other	40	BF	Pipe/wall sealant with Paper
3 217-846-183	1	Plenum	other	40	BF	" " " "
4 217-846-184	3	Plenum	CAD	39	BG	Internal Duct Insulation
5 217-846-185	3	Plenum	CAD	39	BG	" " " "
6 217-846-186	1	Mech Room	other	28	BH	Joint Sealant/Plastic on Fiberglass Pipe Insulation
7 217-846-187	1	Mech Room	other	28	BH	" " " "
8 217-846-188	1	Mech Room	other	28	BH	" " " "
9 217-846-						
10 217-846-						
11 217-846-						
12 217-846-						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION								COMMENTS
	CH	AM	CR	AC	AN	TR			
20082897									
2898									
2899									
2900									
2901									
2902									
2903									
2904									

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT
 JOB NO. 217-08F BATCH NO. ESOA0133 DATE 8/4/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL
 SIGNATURE: *[Signature]*
 TIME COMPLETED: 11-00 DELIVERED TO LAB BY: Fed X
 LAB NAME: NVL LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N. SEATTLE, WASHINGTON 98103
 RECEIVED BY: *[Signature]*
 DATE: 8/8 TIME: 8:30 INITIALS: *[Signature]*
 LAB Q.C. APPROVAL:
 PROJECT MANAGERS APPROVAL:

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. AND PROJECT NAME: 001046

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

DATE: 08/08/00 OF 1 SHEET
 E-MAIL DATA: YES NO X

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET	MATERIAL DESCRIPTION
1 2177-846	B						
2 2177-846	B						
3 2177-846	B						
4 2177-846	B						
5 2177-846	B						
6 2177-846	B						
7 2177-846	B						
8 2177-846	B						
9 2177-846-189	B	1	Roof	RIA	29	BI	Composition Roofing Material - Roll Roofing - So. - thornmost Roof - S14
10 2177-846-190	B	1	Roof	RIA	29	BI	- - - - - ↓
11 2177-846-191	B	1	Roof	RIA	30	BJ	Composition Roofing Material - Roll Roofing - So. - thornmost Walkway Roof
12 2177-846-192	B	1	Roof	RIA	30	BJ	- - - - - ↓

ANALYTICAL LABORATORY RESULTS

LAB ID NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1					
2					
3					
4					
5					
6					
7					
8					
9 2177-846-189					
10 2177-846-190					
11 2177-846-191					
12 2177-846-192					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 2177-00F BATCH NO. EKNABJ33 DATE: 08/08/00
 CLIENT NAME: FUNG ASSOCIATES
 SAMPLERS NAME: W. HARRIS, D. TISDELL.
 SIGNATURE: [Signature]
 TIME COMPLETED: 16:30 DELIVERED TO LAB BY: FELIX
 LAB NAME: SIV LABORATORIES, INC.
 ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103
 RECEIVED BY: [Signature]
 DATE: 8/11/00 TIME: 8:30am INITIALS: TG
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature]
 PROJECT MANAGERS APPROVAL: [Signature]

FAKED

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.)

EDWARD K. NODA AND ASSOCIATES, INC.

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

0010466

DATE: 08/08/00
SHEET 2 OF 3

E-MAIL DATA: YES NO

BLDG. AND PROJECT NAME: ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE I.D. NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1 2177-846-193	B	1	Roof	RIA	31	BK	Composition Roofing Material - Roll Roofing - Central Shell Roof
2 2177-846-194	B	1	Roof	RIA	31	BK	Composition Roofing Material - Roll Roofing - Central Shell Roof
3 2177-846-195	B	1	Roof	RIA	32	BL	Composition Roofing Material - Roll Roofing - Northern Walking Roof
4 2177-846-196	B	1	Roof	RIA	32	BL	Composition Roofing Material - Roll Roofing - Northern Walking Roof
5 2177-846-197	B	1	Roof	RIA	33	BM	Composition Roofing Material - Roll Roofing - Northern Mast Shell Roof
6 2177-846-198	B	1	Roof	RIA	33	BM	Composition Roofing Material - Roll Roofing - Northern Mast Shell Roof
7 2177-846-199	B	1	Mech Room	Hot H ₂ O Tank	34	BN	Hot H ₂ O Tank Insulation
8 2177-846-200	B	1	Mech Room	Hot H ₂ O Tank	34	BN	Hot H ₂ O Tank Insulation
9 2177-846-201	B	1	Mech Room	Hot H ₂ O Tank	34	BN	Hot H ₂ O Tank Insulation
10 2177-846-202	B	3	Hallway	WD2	35	BO	Wall Insulation
11 2177-846-203	B	3	Hallway	WCA2	35	BO	Wall Insulation
12 2177-846-204	B	3	Hallway	WD2	35	BO	Wall Insulation

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	ASBESTOS CONCENTRATION				COMMENTS
	CH	AM	CR	AC	
1 20073066					
2 7667					
3 3668					
4 3669					
5 3690					
6 7691					
7 3692					
8 3693					
9 3694					
10 3695					
11 3696					
12 7697					

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day TAT

JOB NO. 2177-846 BATCH NO. EKN01333 DATE: 08/08/00

CLIENT NAME: FUNG ASSOCIATES

SAMPLERS NAME: W. HARRIS, D. TISDELL

SIGNATURE: W. C. Harris DELIVERED TO LAB BY: FedEx

TIME COMPLETED: 16:30

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. N., SEATTLE, WASHINGTON 98103

RECEIVED BY: Thomson

DATE: 8/11/00 TIME: 8:30am INITIALS: TG

ANALYZED BY: SR

LAB Q.C. APPROVAL: NL

PROJECT MANAGERS APPROVAL: _____

COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, CC)

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

DATE: 08/08/00
SHEET 1 OF 13

E-MAIL DATA: YES NO X

007-12466

BLK. AND PROJECT NAME:

ASBESTOS & LEAD SURVEY; QUAD I and J, SCHOFIELD.

SAMPLE ID NO.	TYPE	FLOOR NO.	AREAROOM	FUNCTION CODE	TYPE CODE	SET*	MATERIAL DESCRIPTION
1	B	2	Hallway	WDA	35	BP	wall Insulation
2	B	2	Hallway	WDA	35	BP	↓
3	B	1	185	F2A	07	BQ	12" x 12" Olive Green Vinyl Floor Tile with Mastic
4	B	1	Exterior	WAI	36	BR	Transite in Appearance Pipe
5	B	1	Exterior	WAI	37	BS	Wall Window Caulking/Sealant
6	B	1	Exterior	WAI	38	BT	Window Caulking
7	B	2	Exterior	WAI	38	BT	↓
8	B	3	Exterior	WAI	38	BT	↓
9	B						
10	B						
11	B						
12	B						

ANALYTICAL LABORATORY RESULTS

LAB ID. NO.	ASBESTOS CONCENTRATION								COMMENTS	
	CH	AM	CR	AC	AN	TR				
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 DAY TAT
 JOB NO. 2177-06F BATCH NO. EKNAB133 DATE: 08/08/00
 CLIENT NAME: ELNG ASSOCIATES
 SAMPLES NAME: W. HARRIS, D. TISDELL
 SIGNATURE: [Signature] DELIVERED TO LAB BY: FedEx
 TIME COMPLETED: 16:30

LAB NAME: NVL LABORATORIES, INC.

ADDRESS: 4708 AURORA AVE. SE SEATTLE, WASHINGTON 98103

RECEIVED BY: [Signature]

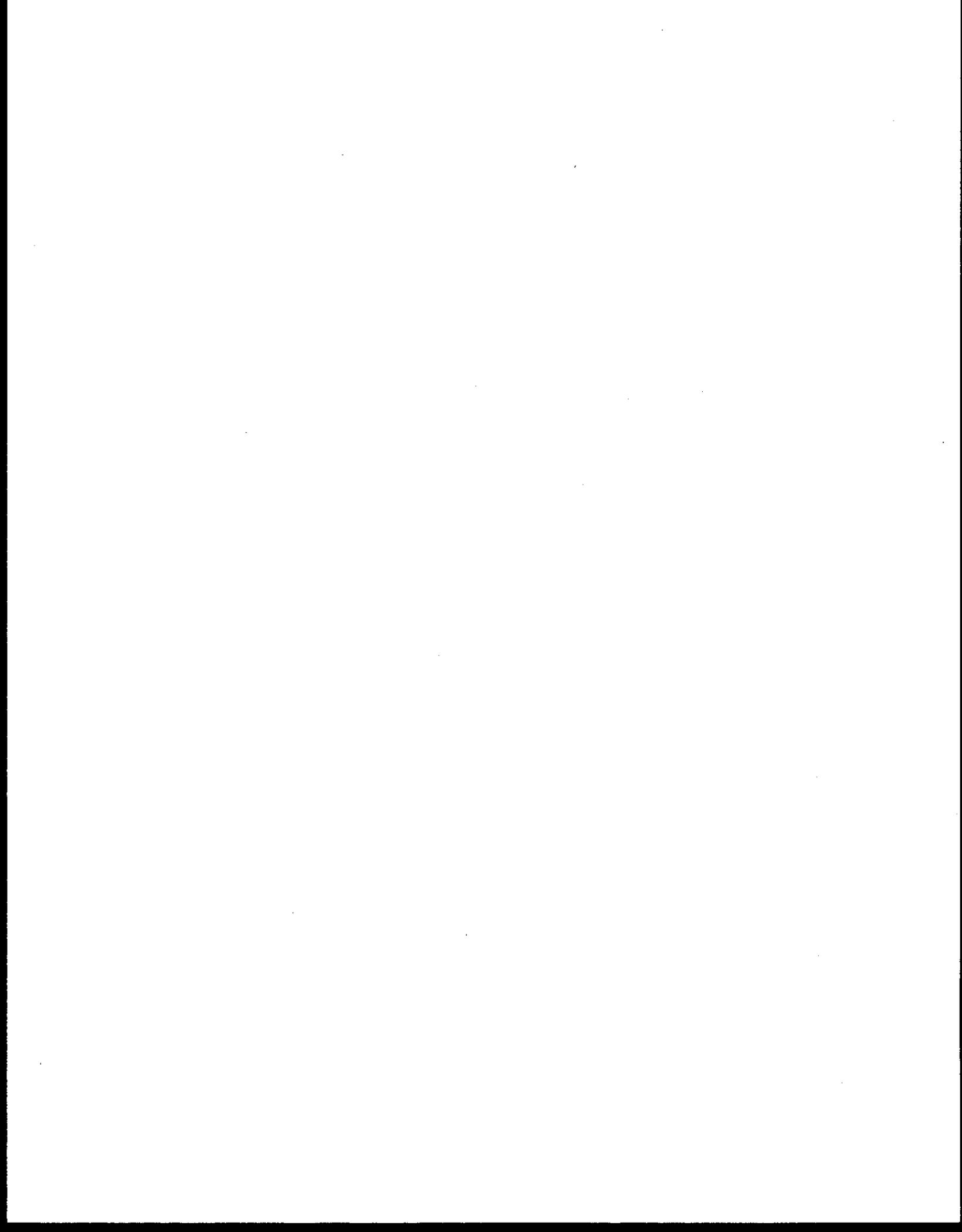
DATE: 8/11/00 TIME: 8:30am INITIALS: TR

ANALYZED BY: SE

LAB Q.C. APPROVAL: [Signature]

PROJECT MANAGERS APPROVAL:

(COMMENT: STOP AT FIRST POSITIVE PER EACH SET (A, B, C, AA, BB, etc.))



NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

Lab ID #: 20076701 Client Sample #: 2177-846-001

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076702 Client Sample #: 2177-846-002

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076703 Client Sample #: 2177-846-003

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/05/2000
Date: 08/05/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

LAYER 1: *None Detected ND
LAYER 2: Chrysotile 4%

Lab ID #: 20076704 Client Sample #: 2177-846-004

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: Chrysotile 4%

Lab ID #: 20076705 Client Sample #: 2177-846-005

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All Bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
 Client Project #: 2177-00F
 Number of samples: 55

Lab ID #: 20076706 Client Sample #: 2177-846-006

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076707 Client Sample #: 2177-846-007

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown tile LAYER 2: Brown/black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix Calcareous matrix
 LAYER 2: Mastic/binder, Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 20076708 Client Sample #: 2177-846-008

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

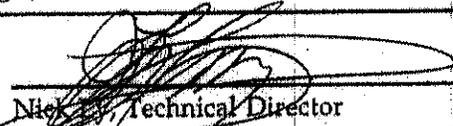
LAYER 1: Calcareous matrix Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/05/2000
 Date: 08/05/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1.9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09929.00

Client Project #: 2177-00F

Number of samples: 55

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 20076709 Client Sample #: 2177-846-009

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Beige tile

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076710 Client Sample #: 2177-846-010

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Asphalt/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: Chrysotile

PERCENT

ND

4%

Lab ID #: 20076711 Client Sample #: 2177-846-011

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Asphalt/binder

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

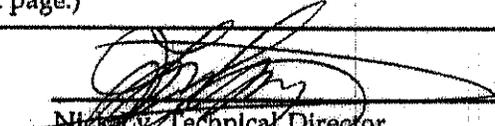
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/05/2000

Date: 08/05/2000


 Nick Ly, Technical Director

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NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09929.00

Client Project #: 2177-00F

Number of samples: 55

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076712 Client Sample #: 2177-846-012

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 20076713 Client Sample #: 2177-846-013

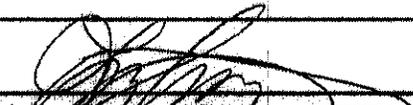
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/05/2000
Date: 08/05/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

Lab ID #: 20076714 Client Sample #: 2177-846-014

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black/brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	<1%

Lab ID #: 20076715 Client Sample #: 2177-846-015

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Black/brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 20076716 Client Sample #: 2177-846-016

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Tan tile LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

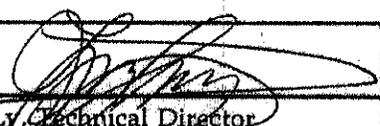
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/05/2000

Date: 08/05/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
 Client Project #: 2177-00F
 Number of samples: 55

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20076717 Client Sample #: 2177-846-017

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Tan tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	5%

Lab ID #: 20076718 Client Sample #: 2177-846-018

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Grey tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/05/2000
 Date: 08/05/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
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NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076719 Client Sample #: 2177-846-019

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076720 Client Sample #: 2177-846-020

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076721 Client Sample #: 2177-846-021

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey tile LAYER 2: White chalky material LAYER 3: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

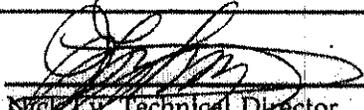
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 5%
LAYER 3: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Calcareous matrix
LAYER 3: Asphalt/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/05/2000	 Nick Ly, Technical Director
Analyzed by: Steve Zhang	Date: 08/05/2000	
Reviewed by: Nick Ly		

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Honolulu, HI 96814

NVL Batch Number: 00-09929.00

Client Project #: 2177-00F

Number of samples: 55

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	4%

Lab ID #: 20076722 Client Sample #: 2177-846-022

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076723 Client Sample #: 2177-846-023

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey tile

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Sample comments: Insufficient amount of black asphaltic mastic is present

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

Lab ID #: 20076724 Client Sample #: 2177-846-024

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076725 Client Sample #: 2177-846-025

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey tile

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Sample comments: Insufficient amount of black asphaltic mastic is present

Lab ID #: 20076726 Client Sample #: 2177-846-026

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Beige tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:

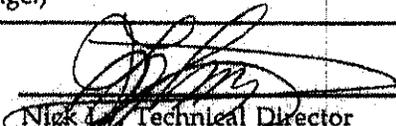
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/05/2000	 Nick Ly, Technical Director
Analyzed by: Steve Zhang	Date: 08/05/2000	
Reviewed by: Nick Ly	Date: 08/05/2000	

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NVL Batch Number: 00-09929.00
 Client Project #: 2177-00F
 Number of samples: 55

(Lab ID#: 20076726 Client Sample #: 2177-846-026 results continued from previous page)

LAYER 2: Chrysotile	3%
---------------------	----

Lab ID #: 20076727 Client Sample #: 2177-846-027

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 20076728 Client Sample #: 2177-846-028

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Black/brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

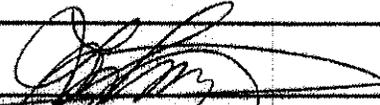
LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/05/2000
 Date: 08/05/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

Lab ID #: 20076729 Client Sample #: 2177-846-029

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Beige tile LAYER 2: Brown adhesive mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Adhesive/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076730 Client Sample #: 2177-846-030

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Green tile**OTHER FIBROUS MATERIALS:**

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20076731 Client Sample #: 2177-846-031

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Green tile**OTHER FIBROUS MATERIALS:**

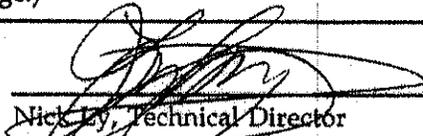
Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/05/2000
Date: 08/05/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
 Client Project #: 2177-00F
 Number of samples: 55

Lab ID #: 20076732 Client Sample #: 2177-846-032

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Brown soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076733 Client Sample #: 2177-846-033

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Brown soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076734 Client Sample #: 2177-846-034

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige tile LAYER 2: Brown soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

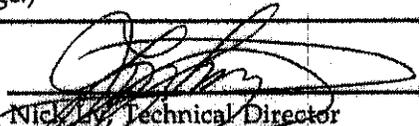
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/05/2000

Date: 08/05/2000


 Nick Ly, Technical Director

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076735 Client Sample #: 2177-846-035

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey tile

OTHER FIBROUS MATERIALS:
Cellulose 2%

NON-FIBROUS MATERIALS:
Calcareous matrix

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076736 Client Sample #: 2177-846-036

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey tile

OTHER FIBROUS MATERIALS:
Cellulose 2%

NON-FIBROUS MATERIALS:
Calcareous matrix

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076737 Client Sample #: 2177-846-037

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey tile

OTHER FIBROUS MATERIALS:
Cellulose 2%

NON-FIBROUS MATERIALS:
Calcareous matrix

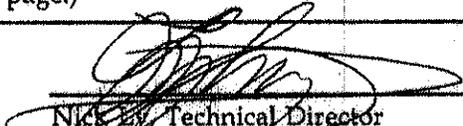
ASBESTOS TYPE:
*None Detected

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09929.00

Client Project #: 2177-00F

Number of samples: 55

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Sample comments: Insufficient amount of black asphaltic mastic is present

Lab ID #: 20076738 Client Sample #: 2177-846-038

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey tile LAYER 2: Black/brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 20076739 Client Sample #: 2177-846-039

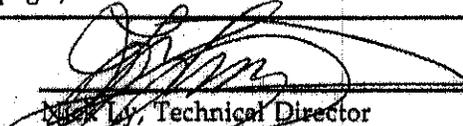
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: White soft mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076740 Client Sample #: 2177-846-040

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown brittle mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/05/2000
Date: 08/05/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076741 Client Sample #: 2177-846-041
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076742 Client Sample #: 2177-846-042
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown brittle mastic

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

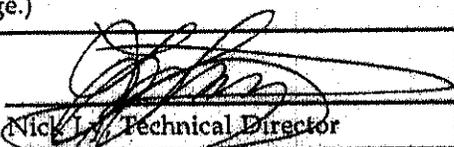
NON-FIBROUS MATERIALS:
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09929.00

Client Project #: 2177-00F
Number of samples: 55

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076743 Client Sample #: 2177-846-043

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown brittle mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076744 Client Sample #: 2177-846-044

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: White soft mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

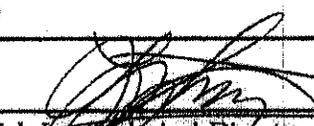
ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076745 Client Sample #: 2177-846-045

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/05/2000
Date: 08/05/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076746 Client Sample #: 2177-846-046

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown brittle mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076747 Client Sample #: 2177-846-047

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

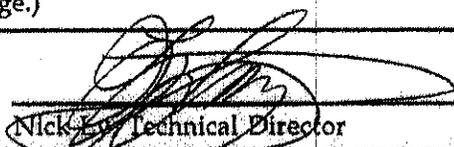
ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

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 Address: 615 Piikoi Street, Suite 300
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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
 Client Project #: 2177-00F
 Number of samples: 55

Lab ID #: 20076748 Client Sample #: 2177-846-048

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076749 Client Sample #: 2177-846-049

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown rubbery material LAYER 2: Brown soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076750 Client Sample #: 2177-846-050

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

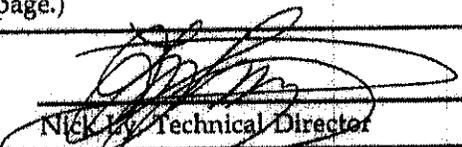
LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/05/2000
 Date: 08/05/2000


 Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Pliikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076751 Client Sample #: 2177-846-051

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076752 Client Sample #: 2177-846-052

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Brown brittle mastic with fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 4%

NON-FIBROUS MATERIALS:

Mastic/binder, Fine particles

ASBESTOS TYPE: PERCENT

*None Detected ND

Lab ID #: 20076753 Client Sample #: 2177-846-053

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

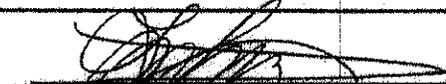
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09929.00
Client Project #: 2177-00F
Number of samples: 55

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076754 Client Sample #: 2177-846-054

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown rubbery material LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076755 Client Sample #: 2177-846-055

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Brown soft mastic

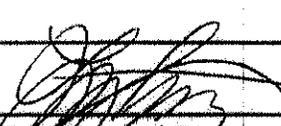
OTHER FIBROUS MATERIALS:
Cellulose 3%

NON-FIBROUS MATERIALS:
Mastic/binder

ASBESTOS TYPE: PERCENT
*None Detected ND

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/05/2000
Date: 08/05/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076756 Client Sample #: 2177-846-056

Sample Location: Quad I and J, Schofield
Description: Tan fibrous material with brown mastic

OTHER FIBROUS MATERIALS:

Cellulose 45%

NON-FIBROUS MATERIALS:

Binder & filler, Mastic/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076757 Client Sample #: 2177-846-057

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Brown mastic, LAYER 2: Tan powdery material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Paint

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 20076758 Client Sample #: 2177-846-058

Sample Location: Quad I and J, Schofield
Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

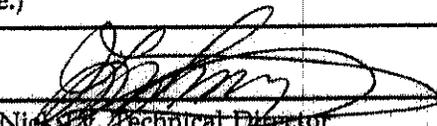
ND

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076759 Client Sample #: 2177-846-059

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076760 Client Sample #: 2177-846-060

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076761 Client Sample #: 2177-846-061

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

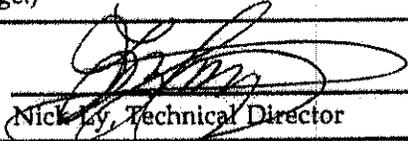
LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076762 Client Sample #: 2177-846-062

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076763 Client Sample #: 2177-846-063

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Tan chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

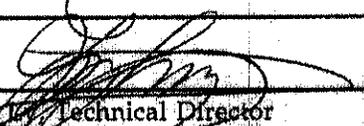
ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

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Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076764 Client Sample #: 2177-846-064

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076765 Client Sample #: 2177-846-065

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076766 Client Sample #: 2177-846-066

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

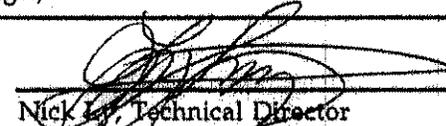
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/04/2000	
Analyzed by: Wei Long Tai	Date: 08/04/2000	
Reviewed by: Nick Ly	Nick Ly, Technical Director	

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076767 Client Sample #: 2177-846-067

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076768 Client Sample #: 2177-846-068

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Tan chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

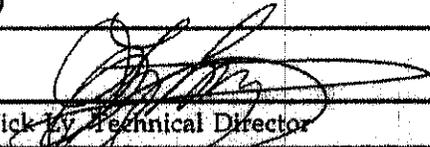
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076769 Client Sample #: 2177-846-069

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076770 Client Sample #: 2177-846-070

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076771 Client Sample #: 2177-846-071

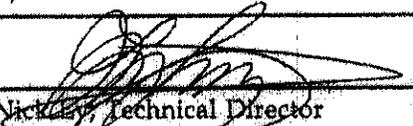
Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/04/2000
Date: 08/04/2000

 Nick Ly, Technical Director

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NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076772 Client Sample #: 2177-846-072

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076773 Client Sample #: 2177-846-073

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Tan chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

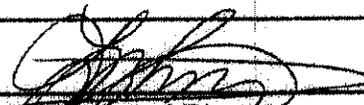
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076774 Client Sample #: 2177-846-074

Sample Location: Quad I and J, Schofield

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 20076775 Client Sample #: 2177-846-075

Sample Location: Quad I and J, Schofield

Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076776 Client Sample #: 2177-846-076

Sample Location: Quad I and J, Schofield

Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

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NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076777 Client Sample #: 2177-846-077

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

PERCENT

ND

Lab ID #: 20076778 Client Sample #: 2177-846-078

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

PERCENT

ND

Lab ID #: 20076779 Client Sample #: 2177-846-079

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

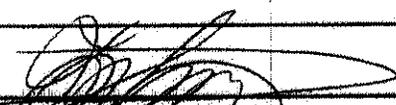
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

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Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076780 Client Sample #: 2177-846-080

Sample Location: Quad I and J, Schofield
Description: White brittle material with paint

OTHER FIBROUS MATERIALS:
Cellulose 3%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 20076781 Client Sample #: 2177-846-081

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:
Cellulose 3%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Granules, Paint
PERCENT
ND

Lab ID #: 20076782 Client Sample #: 2177-846-082

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:
Cellulose 3%

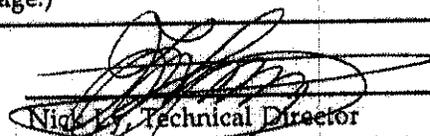
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Granules, Paint
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076783 Client Sample #: 2177-846-083

Sample Location: Quad I and J, Schofield
Description: White sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076784 Client Sample #: 2177-846-084

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076785 Client Sample #: 2177-846-085

Sample Location: Quad I and J, Schofield
Description: White brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 4%

NON-FIBROUS MATERIALS:

Binder & filler, Mica, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

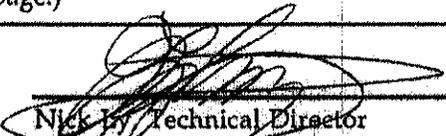
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

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Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076786 Client Sample #: 2177-846-086

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

PERCENT

ND

Lab ID #: 20076787 Client Sample #: 2177-846-087

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

PERCENT

ND

Lab ID #: 20076788 Client Sample #: 2177-846-088

Sample Location: Quad I and J, Schofield
Description: Gray sandy brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Granules

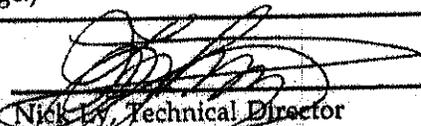
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Honolulu, HI 96814
Attn: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076789 Client Sample #: 2177-846-089

Sample Location: Quad I and J, Schofield
Description: White brittle material with coating and paint

OTHER FIBROUS MATERIALS:

Cellulose 4%

NON-FIBROUS MATERIALS:

Binder & filler, Mica, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076790 Client Sample #: 2177-846-090

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076791 Client Sample #: 2177-846-091

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

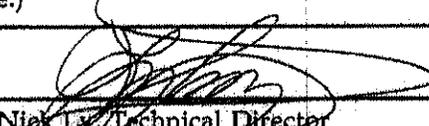
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076792 Client Sample #: 2177-846-092

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076793 Client Sample #: 2177-846-093

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076794 Client Sample #: 2177-846-094

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

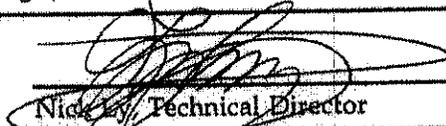
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09930.00
Client Project #: 2177-00P
Number of samples: 65

Lab ID #: 20076795 Client Sample #: 2177-846-095

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 55%, Glass fibers 25%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler**PERCENT**
ND

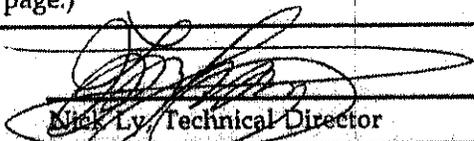
Lab ID #: 20076796 Client Sample #: 2177-846-096

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 55%, Glass fibers 25%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler**PERCENT**
ND

Lab ID #: 20076797 Client Sample #: 2177-846-097

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 55%, Glass fibers 25%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler**PERCENT**
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/04/2000
Date: 08/04/2000
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076798 Client Sample #: 2177-846-098

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076799 Client Sample #: 2177-846-099

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076800 Client Sample #: 2177-846-100

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 20%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

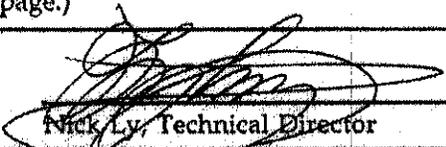
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076801 Client Sample #: 2177-846-101

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 65%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076802 Client Sample #: 2177-846-102

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 65%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076803 Client Sample #: 2177-846-103

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 55%, Glass fibers 17%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

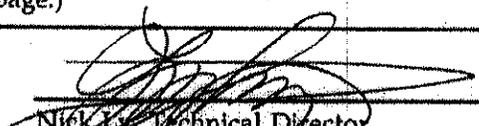
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076804 Client Sample #: 2177-846-104

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 55%, Glass fibers 17%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076805 Client Sample #: 2177-846-105

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 55%, Glass fibers 17%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076806 Client Sample #: 2177-846-106

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**

Cellulose 55%, Glass fibers 17%

ASBESTOS TYPE:

*None Detected

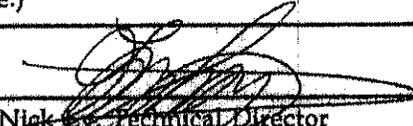
NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/04/2000
Date: 08/04/2000
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076807 Client Sample #: 2177-846-107

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 55%, Glass fibers 17%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076808 Client Sample #: 2177-846-108

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076809 Client Sample #: 2177-846-109

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 70%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

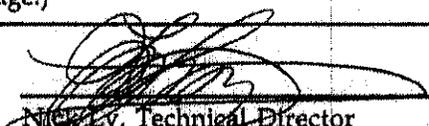
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076810 Client Sample #: 2177-846-110

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 20%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076811 Client Sample #: 2177-846-111

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 20%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20076812 Client Sample #: 2177-846-112

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 20%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

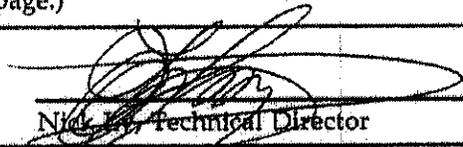
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076813 Client Sample #: 2177-846-113

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 60%, Glass fibers 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler
PERCENT
ND

Lab ID #: 20076814 Client Sample #: 2177-846-114

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 60%, Glass fibers 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler
PERCENT
ND

Lab ID #: 20076815 Client Sample #: 2177-846-115

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating**OTHER FIBROUS MATERIALS:**
Cellulose 60%, Glass fibers 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Binder & filler
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/04/2000
Date: 08/04/2000
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076816 Client Sample #: 2177-846-116

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:
Cellulose 5%, Glass fibers 70%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler
PERCENT
ND

Lab ID #: 20076817 Client Sample #: 2177-846-117

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:
Cellulose 5%, Glass fibers 70%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler
PERCENT
ND

Lab ID #: 20076818 Client Sample #: 2177-846-118

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:
Cellulose 5%, Glass fibers 70%

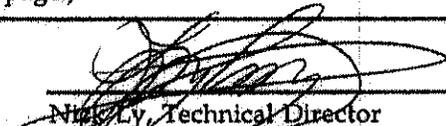
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09930.00
Client Project #: 2177-00F
Number of samples: 65

Lab ID #: 20076819 Client Sample #: 2177-846-119

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 70%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076820 Client Sample #: 2177-846-120

Sample Location: Quad I and J, Schofield
Description: Gray fibrous material with white coating

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 20%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

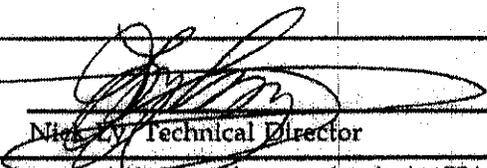
*None Detected

PERCENT

ND

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, SchofieldNVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082837 Client Sample #: 2177-846-121

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix, Perlite
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082838 Client Sample #: 2177-846-122

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix, Perlite
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082839 Client Sample #: 2177-846-123

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix, Perlite
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/11/2000
Date: 08/11/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1.9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20082840 Client Sample #: 2177-846-124

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Perlite
 LAYER 2: Asphalt/binder

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20082841 Client Sample #: 2177-846-125

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

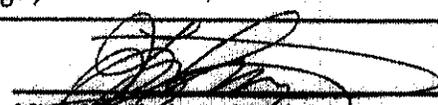
LAYER 1: Calcareous matrix, Perlite
 LAYER 2: Asphalt/binder

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Address: 615 Piikoi Street, Suite 300
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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Lab ID #: 20082842 Client Sample #: 2177-846-126

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Perlite
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082843 Client Sample #: 2177-846-127

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Perlite
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082844 Client Sample #: 2177-846-128

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

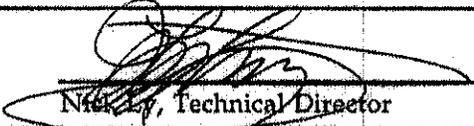
LAYER 1: Paint
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All Bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Sample comments: Asbestos is found at top of the sample

Lab ID #: 20082846 Client Sample #: 2177-846-130

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 25%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082847 Client Sample #: 2177-846-131

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 25%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**

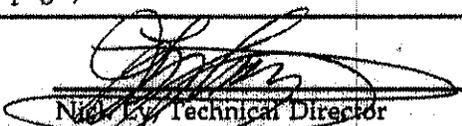
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

Lab ID #: 20082848 Client Sample #: 2177-846-132

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082849 Client Sample #: 2177-846-133

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material LAYER 3: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 25%
 LAYER 3: Cellulose 65%

NON-FIBROUS MATERIALS:

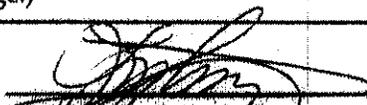
LAYER 1: Paint
 LAYER 2: Asphalt/binder
 LAYER 3: Calcareous matrix, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

Lab ID #: 20082851 Client Sample #: 2177-846-135

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
 LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: *None Detected
 LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Plastic/binder
 LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20082852 Client Sample #: 2177-846-136

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
 LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: *None Detected
 LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

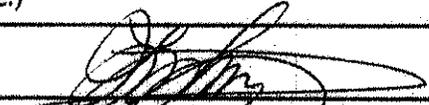
LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Plastic/binder
 LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082853 Client Sample #: 2177-846-137

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: *None Detected
LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Plastic/binder
LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20082854 Client Sample #: 2177-846-138

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: *None Detected
LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

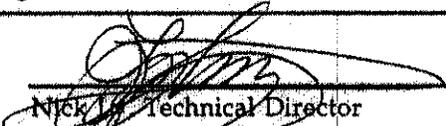
LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Plastic/binder
LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082855 Client Sample #: 2177-846-139

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: *None Detected
LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Plastic/binder
LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20082856 Client Sample #: 2177-846-140

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: *None Detected
LAYER 4: Glass fibers 75%

NON-FIBROUS MATERIALS:

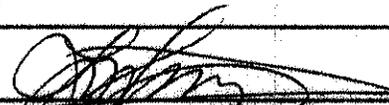
LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Plastic/binder
LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, SchofieldNVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082857 Client Sample #: 2177-846-141

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Grey plastic material with silver foil
LAYER 4: Yellow fluffy fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: *None Detected
LAYER 4: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Plastic/binder
LAYER 4: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20082858 Client Sample #: 2177-846-142

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 5%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20082859 Client Sample #: 2177-846-143

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 5%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

(Sample results are continued on the next page.)

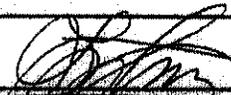
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP

#102063

Client: Edward K. Noda and Associates

NVL Batch Number: 00-10319.00

Address: 615 Pliki Street, Suite 300

Client Project #: 2177-00F

Honolulu, HI 96814

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

Lab ID #: 20082860

Client Sample #: 2177-846-144

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 5%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

Lab ID #: 20082861

Client Sample #: 2177-846-145

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown/white fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20082862

Client Sample #: 2177-846-146

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown/white fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

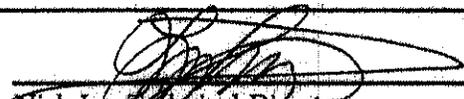
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082863

Client Sample #: 2177-846-147

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown/white fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 35%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082864

Client Sample #: 2177-846-148

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown/white fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 35%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

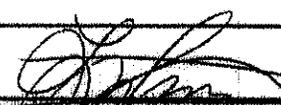
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082865 Client Sample #: 2177-846-149

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown/white fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082866 Client Sample #: 2177-846-150

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

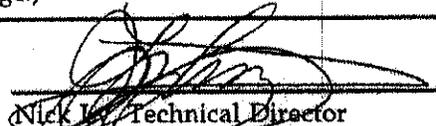
LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082867 Client Sample #: 2177-846-151

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Grey plastic material with silver foil LAYER 4: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles, Plastic/binder
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082868 Client Sample #: 2177-846-152

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

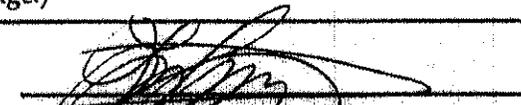
LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Attn: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

Lab ID #: 20082869 Client Sample #: 2177-846-153

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082870 Client Sample #: 2177-846-154

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

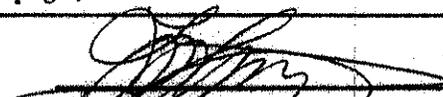
LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

Lab ID #: 20082871 Client Sample #: 2177-846-155

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 45%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Metal foil, Fine particles
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082872 Client Sample #: 2177-846-156

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 45%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

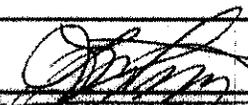
LAYER 1: Calcareous matrix
 LAYER 2: Metal foil, Fine particles
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082873 Client Sample #: 2177-846-157

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:
Glass fibers 45%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Fine particles
PERCENT
ND

Lab ID #: 20082874 Client Sample #: 2177-846-158

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:
Glass fibers 45%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Fine particles
PERCENT
ND

Lab ID #: 20082875 Client Sample #: 2177-846-159

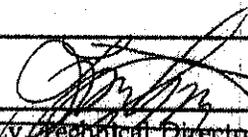
Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:
Glass fibers 45%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Fine particles
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/11/2000	 Nick Ly, Technical Director
Analyzed by: Steve Zhang	Date: 08/11/2000	
Reviewed by: Nick Ly		

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Client: Edward K. Noda and Associates
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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

Lab ID #: 20082876 Client Sample #: 2177-846-160

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown fibrous material LAYER 2: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082877 Client Sample #: 2177-846-161

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown fibrous material LAYER 2: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20082878 Client Sample #: 2177-846-162

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown fibrous material LAYER 2: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

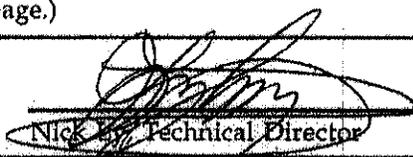
LAYER 1: Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082879 Client Sample #: 2177-846-163

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown fibrous material LAYER 2: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 15%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082880 Client Sample #: 2177-846-164

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with brown fibrous material LAYER 2: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 15%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Client: Edward K. Noda and Associates

NVL Batch Number: 00-10319.00

Address: 615 Piikoi Street, Suite 300

Client Project #: 2177-00F

Honolulu, HI 96814

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

Lab ID #: 20082881

Client Sample #: 2177-846-165

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082882

Client Sample #: 2177-846-166

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Date: 08/11/2000

Reviewed by: Nick Ly

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082883 Client Sample #: 2177-846-167

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082884 Client Sample #: 2177-846-168

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

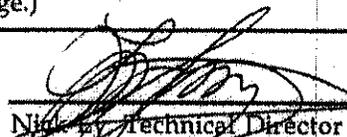
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/11/2000	
Analyzed by: Steve Zhang	Date: 08/11/2000	
Reviewed by: Nick Ly	Date: 08/11/2000	

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

Lab ID #: 20082885

Client Sample #: 2177-846-169

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082886

Client Sample #: 2177-846-170

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Metal foil, Fine particles
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

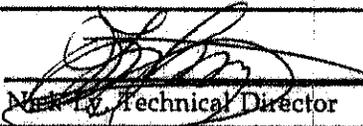
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates

NVL Batch Number: 00-10319.00

Address: 615 Piikoi Street, Suite 300

Client Project #: 2177-00F

Honolulu, HI 96814

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

Lab ID #: 20082887

Client Sample #: 2177-846-171

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: White fine grained calcareous matrix LAYER 2: Silver foil with brown fibrous material LAYER 3: Yellow fluffy fiber

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 25%

LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Metal foil, Fine particles

LAYER 3: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: Chrysotile

2%

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

Lab ID #: 20082888

Client Sample #: 2177-846-172

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 45%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

Lab ID #: 20082889

Client Sample #: 2177-846-173

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 45%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

(Sample results are continued on the next page.)

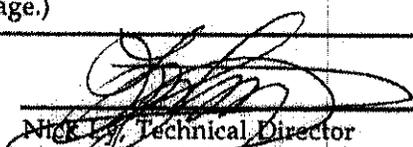
Sampled by: Client

Analyzed by: Steve Zhang

Date: 08/11/2000

Reviewed by: Nick Ly

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

Lab ID #: 20082890 Client Sample #: 2177-846-174

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 45%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20082891 Client Sample #: 2177-846-175

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Silver foil with fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:

LAYER 1: *None Detected
 LAYER 2: *None Detected

PERCENT

ND
 ND

Lab ID #: 20082892 Client Sample #: 2177-846-176

Sample Location: Asbestos & Lead Survey; I and J, Schofield
 Description: LAYER 1: Silver foil with fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:

LAYER 1: *None Detected
 LAYER 2: *None Detected

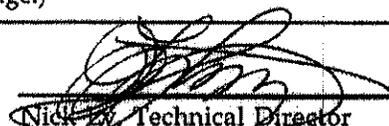
PERCENT

ND
 ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis**NVLAP**

#102063

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NVL Batch Number: 00-10319.00

Address: 615 Piikoi Street, Suite 300

Client Project #: 2177-00F

Honolulu, HI 96814

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

Lab ID #: 20082893

Client Sample #: 2177-846-177

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20082894

Client Sample #: 2177-846-178

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20082895

Client Sample #: 2177-846-179

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Silver foil with fibrous material LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

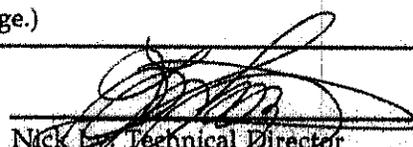
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/11/2000

Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10319.00

Client Project #: 2177-00F

Number of samples: 66

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; I and J, Schofield

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082896 Client Sample #: 2177-846-180

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Brown/black fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 65%

NON-FIBROUS MATERIALS:

Fine particles, Asphalt/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20082897 Client Sample #: 2177-846-181

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black fibrous material

OTHER FIBROUS MATERIALS:

Glass fibers 75%

NON-FIBROUS MATERIALS:

Fine particles

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20082898 Client Sample #: 2177-846-182

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: LAYER 1: White soft calcareous matrix LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Fine particles

ASBESTOS TYPE:

LAYER 1: *None Detected

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

(Lab ID#: 20082898 Client Sample #: 2177-846-182 results continued from previous page)

LAYER 2: *None Detected ND

Lab ID #: 20082899 Client Sample #: 2177-846-183

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: LAYER 1: White soft calcareous matrix LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20082900 Client Sample #: 2177-846-184

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black fibrous material

OTHER FIBROUS MATERIALS:

Glass fibers 75%

NON-FIBROUS MATERIALS:

Fine particles

ASBESTOS TYPE: PERCENT

Chrysotile <1%

Sample comments: Asbestos appears to be surface contamination

Lab ID #: 20082901 Client Sample #: 2177-846-185

Sample Location: Asbestos & Lead Survey; I and J, Schofield
Description: Black fibrous material

OTHER FIBROUS MATERIALS:

Glass fibers 75%

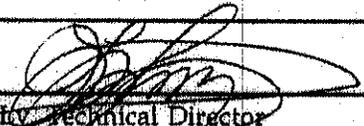
NON-FIBROUS MATERIALS:

Fine particles

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
 Client Project #: 2177-00F
 Number of samples: 66

ASBESTOS TYPE:	PERCENT
Chrysotile	<1%

Sample comments: Asbestos appears to be surface contamination

Lab ID #: 20082902 Client Sample #: 2177-846-186

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige plastic material LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 5%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Plastic/binder
 LAYER 2: Metal foil
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20082903 Client Sample #: 2177-846-187

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige plastic material LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 5%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Plastic/binder
 LAYER 2: Metal foil
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/11/2000
 Date: 08/11/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

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Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; I and J, Schofield

NVL Batch Number: 00-10319.00
Client Project #: 2177-00F
Number of samples: 66

Lab ID #: 20082904 Client Sample #: 2177-846-188

Sample Location: Asbestos & Lead Survey; I and J, Schofield

Description: LAYER 1: Beige plastic material LAYER 2: Silver foil with fibrous material LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 5%
LAYER 3: Glass fibers 75%

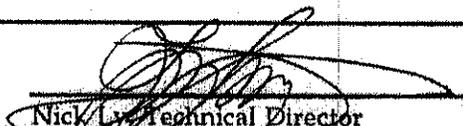
NON-FIBROUS MATERIALS:

LAYER 1: Plastic/binder
LAYER 2: Metal foil
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/11/2000
Date: 08/11/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10466.00
Client Project #: 2177-00F
Number of samples: 24

Lab ID #: 20083682 Client Sample #: 2177-846-189

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material

OTHER FIBROUS MATERIALS:
Cellulose 4%, Glass fibers 35%

NON-FIBROUS MATERIALS:
Asphalt/binder

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083683 Client Sample #: 2177-846-190

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:
Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:
Asphalt/binder, Mineral/binder

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083684 Client Sample #: 2177-846-191

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black asphaltic material with surface mineral grains LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 3%, Glass fibers 35%
LAYER 2: Cellulose 35%

NON-FIBROUS MATERIALS:
LAYER 1: Asphalt/binder, Mineral/binder
LAYER 2: Fine particles, Perlite

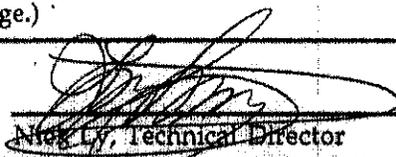
ASBESTOS TYPE:
LAYER 1: *None Detected
LAYER 2: *None Detected

PERCENT
ND
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10466.00
Client Project #: 2177-00F
Number of samples: 24

Lab ID #: 20083685 **Client Sample #: 2177-846-192**

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:
Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:
Asphalt/binder, Mineral/binder

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20083686 **Client Sample #: 2177-846-193**

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black asphaltic material with surface mineral grains LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 3%, Glass fibers 35%
LAYER 2: Cellulose 35%

NON-FIBROUS MATERIALS:
LAYER 1: Asphalt/binder, Mineral/binder
LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:
LAYER 1: *None Detected
LAYER 2: *None Detected

PERCENT
ND
ND

Lab ID #: 20083687 **Client Sample #: 2177-846-194**

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:
Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:
Asphalt/binder, Mineral/binder

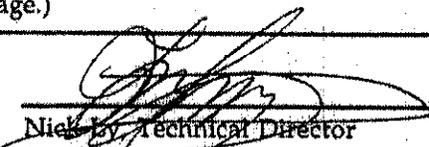
ASBESTOS TYPE:
*None Detected

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000
Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10466.00
 Client Project #: 2177-00F
 Number of samples: 24

Lab ID #: 20083688 Client Sample #: 2177-846-195

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083689 Client Sample #: 2177-846-196

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083690 Client Sample #: 2177-846-197

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Black asphaltic material with surface mineral grains LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%, Glass fibers 35%
 LAYER 2: Cellulose 35%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder, Mineral/binder
 LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

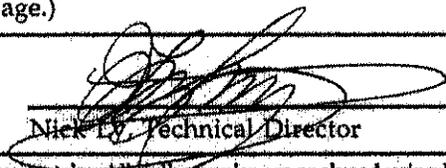
ND

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/18/2000
 Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10466.00

Client Project #: 2177-00F

Number of samples: 24

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083691 Client Sample #: 2177-846-198

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083692 Client Sample #: 2177-846-199

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix with silver foil LAYER 2: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Metal foil
LAYER 2: Glass beads

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 20083693 Client Sample #: 2177-846-200

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix with silver foil LAYER 2: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Metal foil
LAYER 2: Glass beads

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

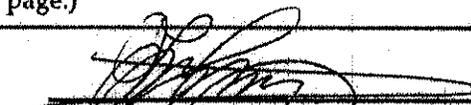
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10466.00

Client Project #: 2177-00F

Number of samples: 24

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083694 Client Sample #: 2177-846-201

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix with silver foil LAYER 2: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix, Metal foil
LAYER 2: Glass beads**ASBESTOS TYPE:**LAYER 1: *None Detected
LAYER 2: *None Detected**PERCENT**ND
ND

Lab ID #: 20083695 Client Sample #: 2177-846-202

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 75%

NON-FIBROUS MATERIALS:

Fine particles

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20083696 Client Sample #: 2177-846-203

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 75%

NON-FIBROUS MATERIALS:

Fine particles

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

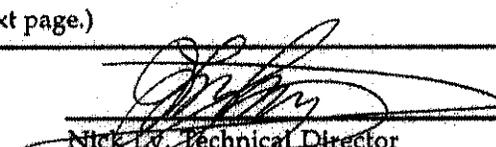
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/18/2000

Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10466.00
Client Project #: 2177-00F
Number of samples: 24

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20083697 Client Sample #: 2177-846-204

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 75%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Fine particles

PERCENT

ND

Lab ID #: 20083698 Client Sample #: 2177-846-205

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 75%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Fine particles

PERCENT

ND

Lab ID #: 20083699 Client Sample #: 2177-846-206

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 75%

ASBESTOS TYPE:

*None Detected

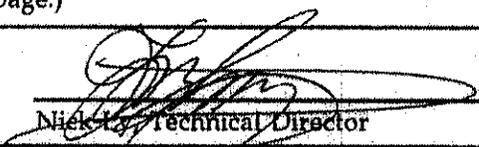
NON-FIBROUS MATERIALS:

Fine particles

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/18/2000	
Analyzed by: Steve Zhang	Date: 08/18/2000	
Reviewed by: Nick Ly	Date: 08/18/2000	

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-10466.00
 Client Project #: 2177-00F
 Number of samples: 24

Lab ID #: 20083700 Client Sample #: 2177-846-207

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Grey tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 20083701 Client Sample #: 2177-846-208

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous calcareous matrix

OTHER FIBROUS MATERIALS:

Cellulose 4%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
Chrysotile	35%
Crocidolite	10%

Lab ID #: 20083702 Client Sample #: 2177-846-209

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey elastic material

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/18/2000
 Date: 08/18/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-10466.00
Client Project #: 2177-00F
Number of samples: 24

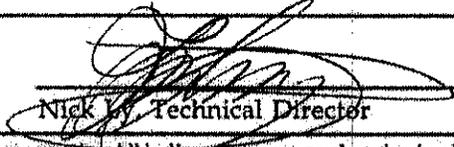
Lab ID #: 20083703 Client Sample #: 2177-846-210

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey elastic material with surface paint**OTHER FIBROUS MATERIALS:**
Cellulose 3%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint
PERCENT
ND

Lab ID #: 20083704 Client Sample #: 2177-846-211

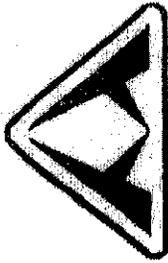
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey elastic material with surface paint**OTHER FIBROUS MATERIALS:**
Cellulose 3%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint
PERCENT
ND

Lab ID #: 20083705 Client Sample #: 2177-846-212

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey elastic material with surface paint**OTHER FIBROUS MATERIALS:**
Cellulose 3%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint
PERCENT
NDSampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/18/2000
Date: 08/18/2000
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

APPENDIX G
INSPECTOR CERTIFICATES



MURANAKA ENVIRONMENTAL CONSULTANTS, INC.

Training Certificate

This is to certify that

WILLIAM HARRIS

has attended the

AHERA Inspector/Management Planner

Refresher Course

Accredited Under ES&EA Title II

Certificate number: LAVII-MEC-AIMPR-080995-01

August 5, 1999

Date of Attendance

August 5, 2000

Expiration Date

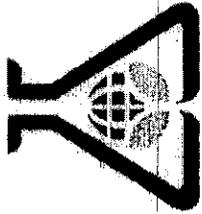
Training Provider:
Muranaka Environmental Consultants, Inc.
500 Ala Kawa Street, Building 220, 2nd Floor
Honolulu, Hawaii 96817

Phone: (808) 848-8866

Fax: (808) 847-5267

Mark T. Muranaka, M.S., M.P.H.

President



Brewer Environmental Services

Training Certificate

This is to certify that

WILLIAM HARRIS

has attended the

AHERA Inspector/Management Planner Refresher Course
Accredited Under ISCA Title II

Certificate number: LAVII-MEC-AIMPR-080995-18

August 4, 2000

Date of Attendance

August 4, 2001

Expiration Date

Training Provider:

BES IH Group

500 Ala Kawa Street, Building 220, 2nd Floor

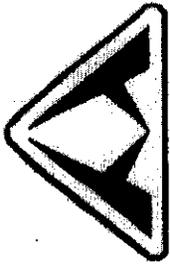
Honolulu, Hawaii 96817

Phone: (808) 848-8866

Fax: (808) 847-5267

Mark T. Murrainaka, M.S., M.P.H.

Director, IH Group



MURANAKA ENVIRONMENTAL CONSULTANTS, INC.

Training Certificate

This is to certify that

DOUGLAS G. TISDELL

has attended the

AHERA Inspector/Management Planner

Refresher Course

Accredited Under ISCA Title II

Certificate number: LAYII-MEC-AIMP-102398-05

September 3, 1999

Date of Attendance

September 3, 2000

Expiration Date

Training Provider:
Muranaka Environmental Consultants, Inc.
500 Ala Kawa Street, Building 220, 2nd Floor
Honolulu, Hawaii 96817
Phone: (808) 848-8866
Fax: (808) 847-5267

Mark T. Muranaka, M.S., M.P.H.
President

APPENDIX H
LABORATORY CERTIFICATES

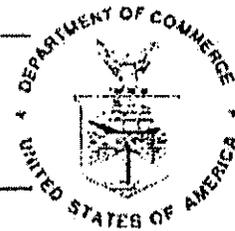
National Institute
of Standards and Technology



National Voluntary
Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation



Page: 1 of 1

BULK ASBESTOS FIBER ANALYSIS

NVLAP LAB CODE 102063-0

NVL LABORATORIES, INC.

4708 Aurora Avenue N.

Seattle, WA 98103

Mr. Nghiep Vi Ly

Phone: 206-547-0100 Fax: 206-634-1936

E-Mail: muna@nvlabs.com

URL: <http://www.nvlabs.com>

NVLAP Code

Designation

18/A01

EPA-600/M4-82-020: Interim Method for the Determination of Asbestos in Bulk Insulation Samples

September 30, 2000

Effective through

For the National Institute of Standards and Technology

United States Department of Commerce
National Institute of Standards and Technology

NVLAP[®]



ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

NVL LABORATORIES, INC.
SEATTLE, WA

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BULK ASBESTOS FIBER ANALYSIS

September 30, 2000

Effective through

of the National Institute of Standards and Technology

NVLAP Lab Code: 102063-4

Part 2

**PCB Ballast and UST Inspection Report
by Fung Associates**

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I.	EXECUTIVE SUMMARY	1
II.	INTRODUCTION	2
III.	SURVEY METHODOLOGY	2
IV.	SURVEY FINDINGS	2
V.	DISCUSSIONS	3
VI.	RECOMMENDATIONS	3
VII.	LIMITATIONS	4

APPENDICES

APPENDIX I	BUILDING T-754
APPENDIX J	BUILDING T-756
APPENDIX K	BUILDING T-758
APPENDIX L	BUILDING T-759
APPENDIX M	BUILDING 845 (QUAD J)
APPENDIX N	BUILDING 846 (QUAD J)

I. EXECUTIVE SUMMARY

The scope of this project is to conduct a survey and document for Buildings T-754, T-756, T-758, T-759, and Buildings 845 and 846 at Quad J, Schofield Barracks, for possible PCB light ballasts. These structures, scheduled to be demolished, are assumed to have contained PCB light ballasts.

Most of the light fixtures are fluorescent lights which require ballasts. Due to the age of the building, it is reasonable to presume the presence of PCB ballasts within the housing of these fixtures. Presence of PCB ballasts will require abatement efforts prior to demolition of the building.

A survey was conducted in July and August of 2000 for a portion of the buildings. A summary of the survey results is outlined as follows:

Building T-754

- 6 fixture types
- approximately 240 fixtures total
- 126 fixtures surveyed, 13 of them contained PCB ballasts
- approximately 10% of surveyed fixtures contain PCB ballasts

Building T-756

- 2 fixture types
- approximately 60 fixtures total
- 25 fixtures surveyed, 2 of them contained PCB ballasts
- approximately 8% of surveyed fixtures contain PCB ballasts

Building T-758

- 3 fixture types
- approximately 50 fixtures total
- 21 fixtures surveyed, 3 of them contained PCB ballasts
- approximately 14% of surveyed fixtures contain PCB ballasts

Building T-759

- 1 fixture type
- approximately 30 fixtures total
- 12 fixtures surveyed, none of them contained PCB ballasts

Building 845

- 8 fixture types
- approximately 1,200 fixtures total
- 395 fixtures surveyed, 83 of them contained PCB ballasts
- approximately 21% of surveyed fixtures contain PCB ballasts

Building 846

- 8 fixture types
- approximately 1,300 fixtures total
- 420 fixtures surveyed, 134 of them contained PCB ballasts
- approximately 32% of surveyed fixtures contain PCB ballasts

II. INTRODUCTION

The objective of this survey is to assess the existence and extent of PCB light ballasts for Buildings T-754, T-756, T-758, T-759, and Buildings 845 and 846 at Quad J, Schofield Barracks. The quad buildings (Buildings 845 and 846) are a three-storied WWII concrete structure. The first floor of each building is office space and the second and third floors are the soldiers living quarters. Buildings T-754, T-756, T-758 and T-759 are one-storied buildings (T-758 and T-759 also consist of small mezzanine areas) used for storage and training.

Fung Associates' scope of work is to provide an investigative PCB light ballast survey and a written report summarizing the survey with sampling results for these buildings.

III. SURVEY METHODOLOGY

Between July 19th and August 10th, 2000, Louis Fung, Canossa Choy and Venice Au of Fung Associates conducted an investigative survey for PCB light ballasts for Buildings T-754, T-756, T-758, T-759, and Buildings 845 and 846 at Quad J, Schofield Barracks. In general, the survey will cover a minimum of 15% of the total number of fixtures for each floor. Assuming a fair amount of consistency in the presence of PCB light ballasts, the results of the survey findings may be used to project an estimated number of PCB ballasts for the entire floor or building.

A list of different light fixture types was generated and the survey was conducted to cover at least a fair amount of samples from each area of each individual floor, including both ceiling and wall mounted fixtures. The following elements were recorded during the survey:

- Type of light fixture
- Number of light fixtures surveyed
- Number of light fixtures containing PCB light ballasts

IV. SURVEY FINDINGS

Based on the field survey, only five fixture types were detected at this building and they are described as follows:

- Type "A": 2-tube recessed ceiling fluorescent fixture
- Type "A1": 4-tube recessed ceiling fluorescent fixture

Type "B":	1-tube surface mounted fluorescent fixture
Type "C":	2-tube suspended fluorescent fixture
Type "D":	wall mounted corridor fixture
Type "E":	wall mounted stair fixture
Type "F":	exterior wall mounted fixture
Type "G":	suspended fixture
Type "H":	suspended fixture
Type "I":	4-tube suspended fluorescent fixture
Type "J":	2-tube surface mounted fluorescent fixture

The results of the PCB ballasts survey are provided in the appendices. Each appendix consists of the following:

Introduction

- Building name and/or designated number
- Brief description of the building

Summary of survey

V. DISCUSSIONS

Because of PCBs toxicity, persistence and potential ecological damage via water pollution, manufacture of PCB was discontinued in the U.S. in the late 1970s. Most older fluorescent light ballasts have small capacitors that contain high concentrations of PCBs. Nearly all ballasts manufactured before 1979 contain PCBs. All ballasts manufactured after July 1, 1978 that do not contain PCBs are required to be clearly marked "No PCBs". Unmarked ballasts or ballasts without a date code should be assumed to be PCB ballasts.

PCBs are toxic chemicals according to U.S. EPA. While there is only a small amount, about one ounce, of PCBs in each light ballast capacitor, there is a large number of ballasts in the U.S. Large quantities of PCB ballasts should be treated as if they were a regulated PCB waste and disposal may be possible at chemical waste landfills, ballast decap recycling processing, or high-temperature incinerators.

As a result of this survey, PCB ballasts are found to be present at these buildings, and therefore the waste should be treated in accordance with EPA recommendations.

VI. RECOMMENDATIONS

Demolition of these buildings will result in disturbance of the PCB ballasts and abatement is generally required prior to demolition. Due to the presence of PCB ballasts, a licensed abatement contractor will be required to perform this work.

Care should be used in the removal of PCB ballasts. Although very few ballasts leak (undetected throughout our survey for all buildings), those that are leaking can usually be identified with clear or yellow oil on the surface of a ballast. Chemically resistant gloves should be used when handling the ballast and ballasts should not be thrown as leaks could result. Ballasts should be placed in double heavy plastic bag. Technically, if PCB ballasts are leaking, they must be disposed of as regulated hazardous waste.

VII. LIMITATIONS

Fung Associates conducted this survey while the facility was abandoned except for the ground floor offices. Sampling was performed only for areas that were accessible at the time of the survey. Results of the survey reflect only the conditions at the time of the survey and conditions may vary at a different time due to regular and necessary replacement of light ballasts. As the survey does not cover all areas, unsurveyed areas should be checked for presence of PCB ballasts prior to demolition of the buildings.

The information set forth is based solely on the agreed upon scope of services. This information is based on personal observation at the field. Fung Associates expressly disclaims any and all liability representations, expressed, or implied, contained in, or for omissions from this report, or any other written or oral communication which might be interpreted as establishing the total extent of all liability present at the subject property.

Our services have been performed with the usual thoroughness and competence of the consulting profession, in accordance with the standards of professional services at this time. No other warranty or representation, either expressed or implied, is included or intended.

Part 2-A

PCB Ballast Inspection Report

APPENDIX I
BUILDING T-754

BUILDING T-754

I. INTRODUCTION

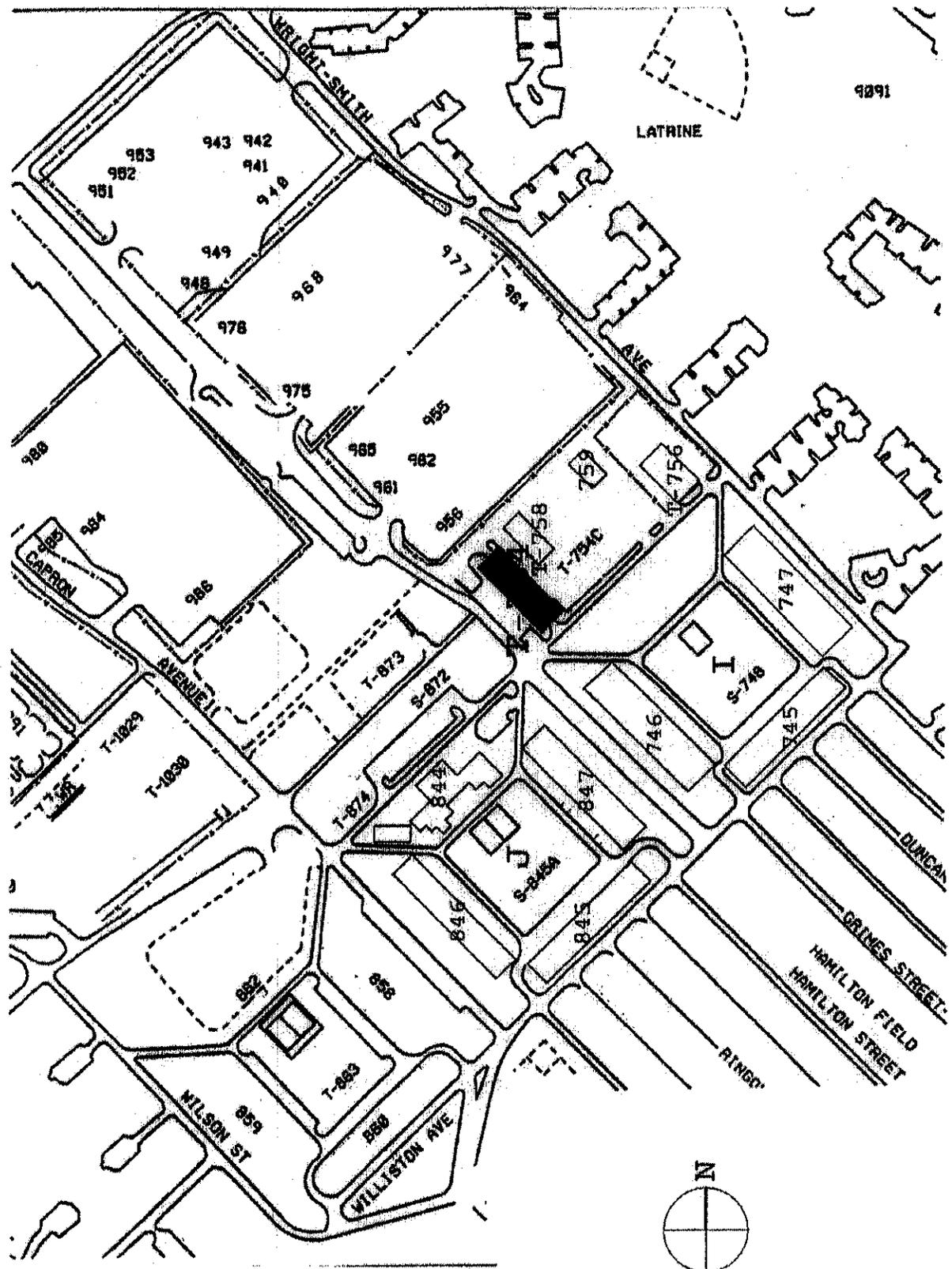
Building T-754 is occupied by the MOSIT Center, Unit Armorer School and Artillery Training. The building was previously a warehouse. The front section of the building was a former motor pool. It is slab on grade construction. The interior of the building is comprised of wood and steel beams. The siding and roof material consist of painted corrugated metal.

II. SUMMARY OF SURVEY

Based on the field survey, only six fixture types were detected at this building and they are described as follows:

- Type "A": 2-tube recessed ceiling fluorescent fixture
- Type "A1": 4-tube recessed ceiling fluorescent fixture
- Type "B": 1-tube surface mounted fluorescent fixture
- Type "C": 2-tube suspended fluorescent fixture
- Type "H": suspended fixture
- Type "I": 4-tube suspended fluorescent fixture

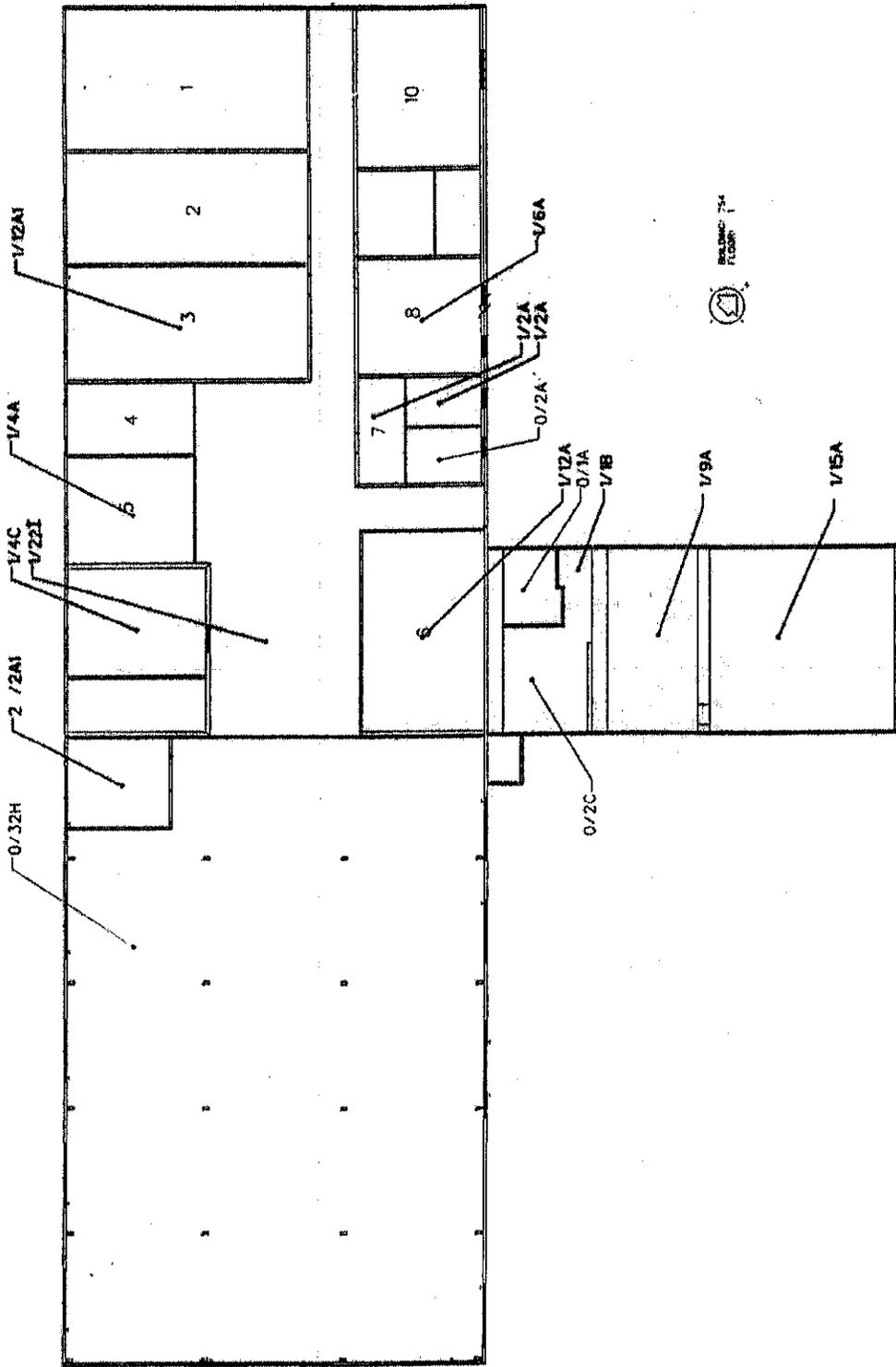
A total of 126 light fixtures were surveyed out of approximately 240 fixtures existing at Building T-754 (This number of total fixtures is only an estimate, rooms not covered in the survey are assumed to contain similar number of fixtures as the adjacent rooms). Only 13 fixtures were found to contain PCB light ballasts which is equivalent to approximately 10% of the fixtures surveyed.



The Demolition Survey for Buildings 747, I-754, I-758, I-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACAS3-00-D-0007, I.O. 0003

Sample Location Plan
 Building 754

FIGURE
 I-1



X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

APPENDIX J
BUILDING T-756

BUILDING T-756

I. INTRODUCTION

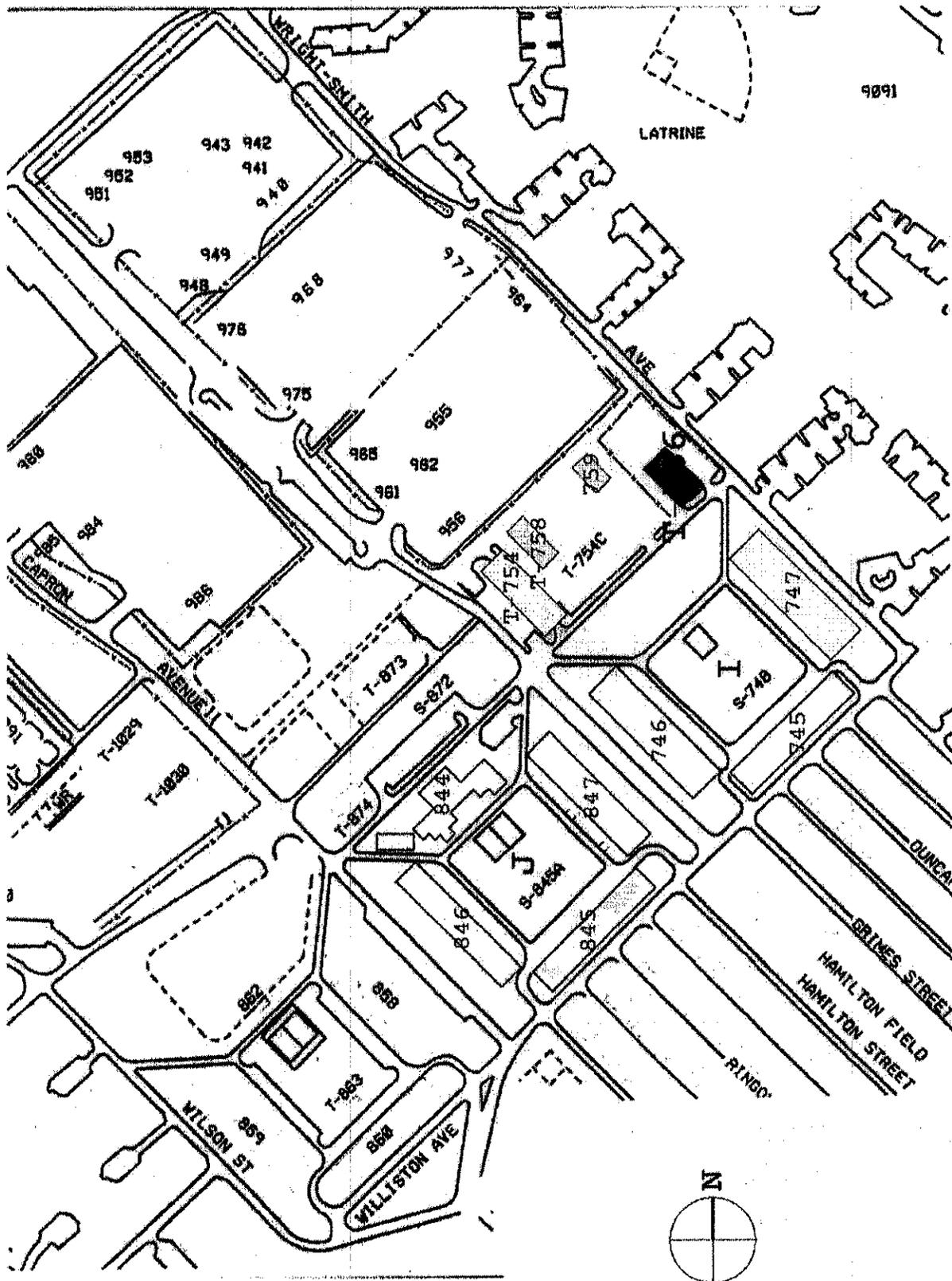
Building T-756 houses HHB DivArty Storage, 25th FAD parts storage and HHB DiveArty Fire Support Office. It is presently used for storage and repair of equipment. Three offices are located at the back of the building. There are three temporary buildings located at this site. TF0756 (storage), TC0756 (flammable storage) and TA0756 (outdoor latrine) which should be included in this survey. This building is slab on grade construction and build of corrugated siding and roofing material. The flooring is bare concrete.

II. SUMMARY OF SURVEY

Based on the field survey, only two fixture types were detected at this building and they are described as follows:

- Type "C": 2-tube suspended fluorescent fixture
- Type "J": 2-tube surface mounted fluorescent fixture

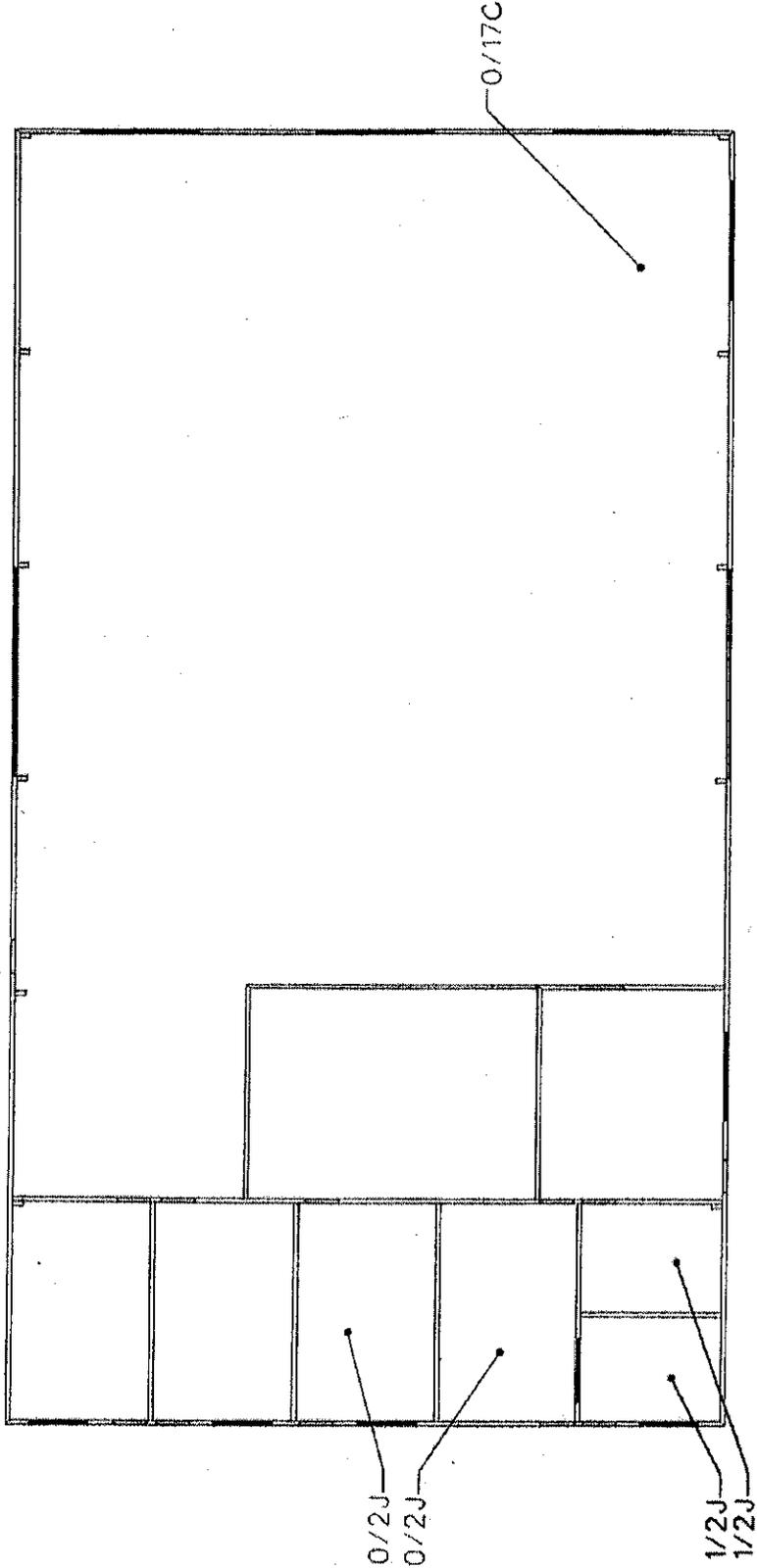
A total of 25 light fixtures were surveyed out of approximately 60 fixtures existing at Building T-756 (This number of total fixtures is only an estimate, rooms not covered in the survey are assumed to contain similar number of fixtures as the adjacent rooms). Only 2 fixtures were found to contain PCB light ballasts which is equivalent to approximately 8% of the fixtures surveyed.



Sample Location Plan
Building 756

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schrieff Barracks, Island of Oahu, Hawaii.
DACA83-00-D-0007, T.O. 0003

FIGURE
J-1



APPENDIX K
BUILDING T-758

BUILDING T-758

I. INTRODUCTION

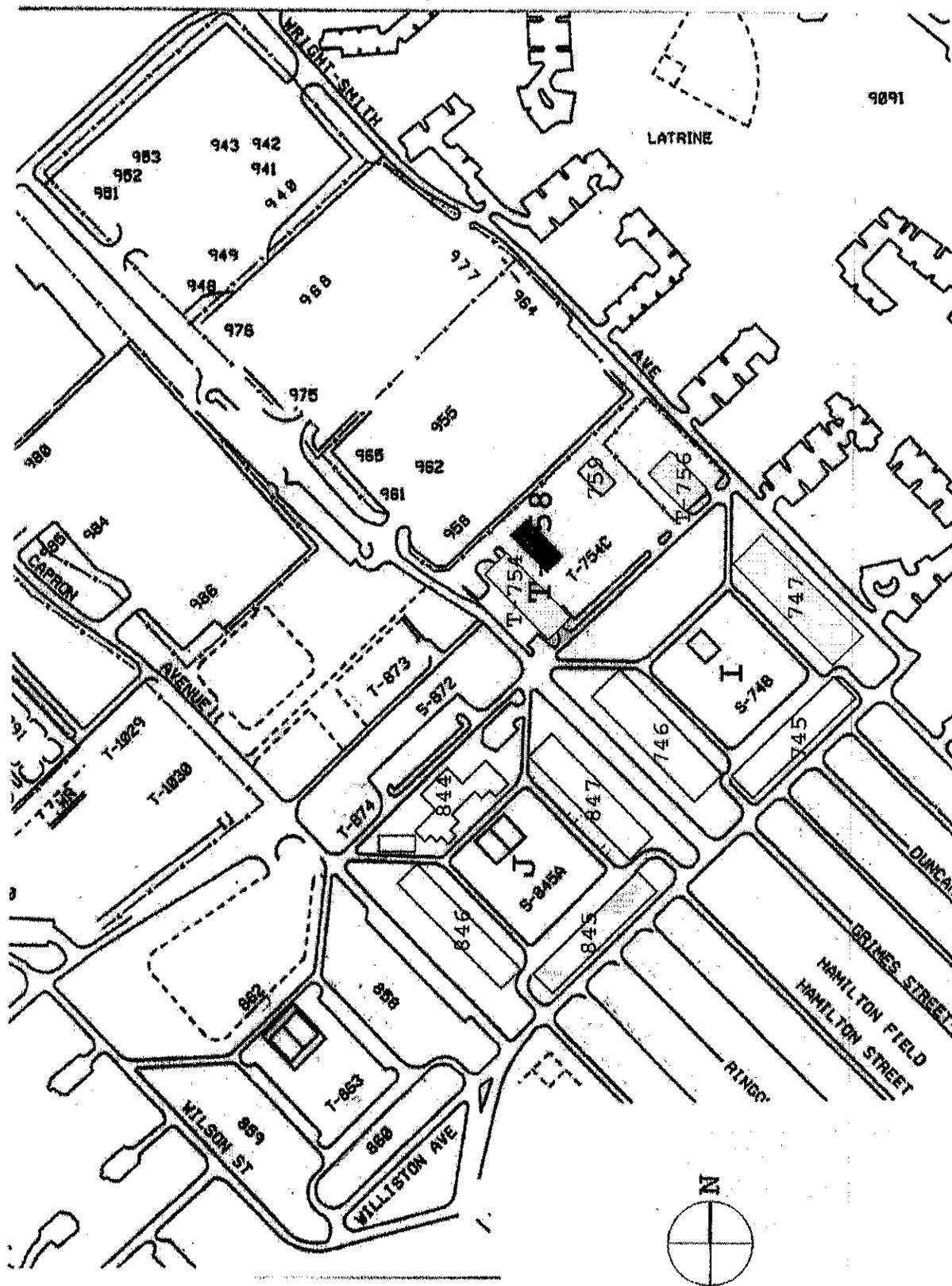
Building T-758 is part of the motor pool training center. The building is set up like a motor pool but is strictly used for training. It is slab on grade construction and built of prefabricated metal.

II. SUMMARY OF SURVEY

Based on the field survey, only three fixture types were detected at this building and they are described as follows:

Type "C": 2-tube suspended fluorescent fixture
Type "D": wall mounted corridor fixture
Type "H": suspended fixture

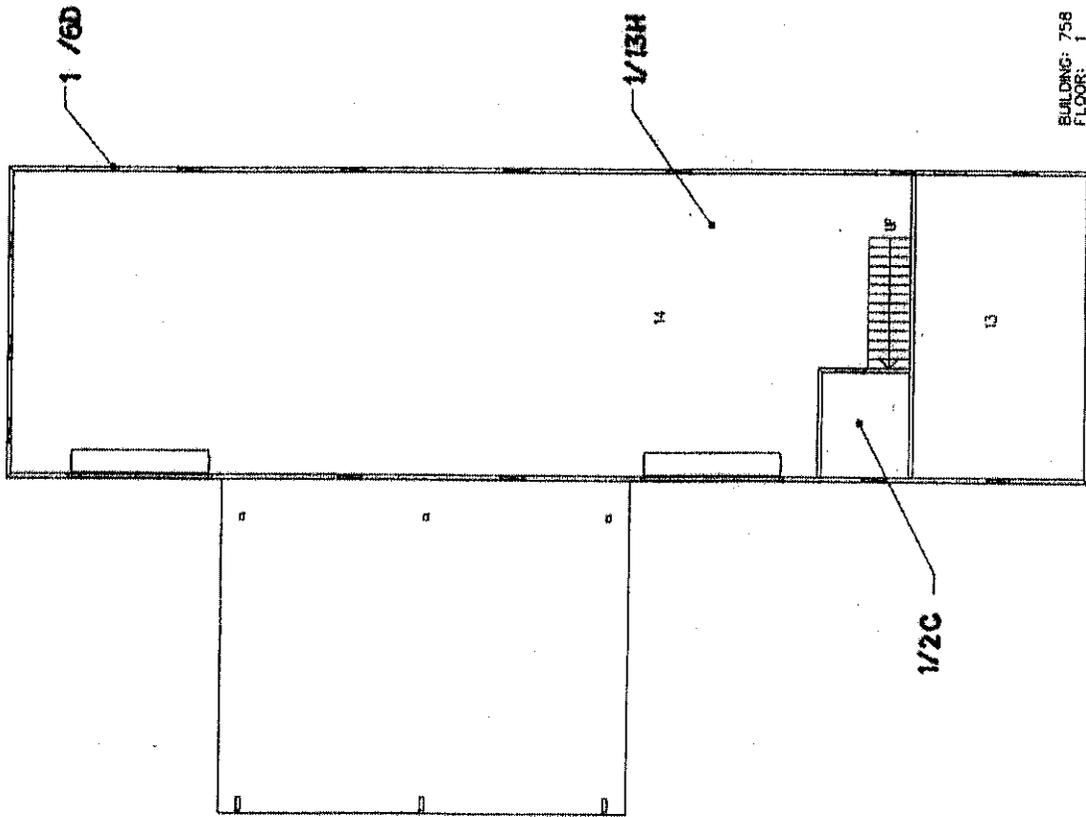
A total of 21 light fixtures were surveyed out of approximately 50 fixtures existing at Building T-758 (This number of total fixtures is only an estimate, rooms not covered in the survey are assumed to contain similar number of fixtures as the adjacent rooms). Only 3 fixtures were found to contain PCB light ballasts which is equivalent to approximately 14% of the fixtures surveyed.



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-60-D-0007, T.O. 0003

Sample Location Plan
 Building 758

FIGURE
 K-1



BUILDING: 758
FLOOR: 1



0 5 15 25 FT

X/Y Z

X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

The Demolition Survey for Buildings 747, T-754, T-755, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DAC-83-00-D-0007, T.O. 0003

Sample Location Plan
Building 758

FIGURE

K-2

APPENDIX L
BUILDING T-759

BUILDING T-759

I. INTRODUCTION

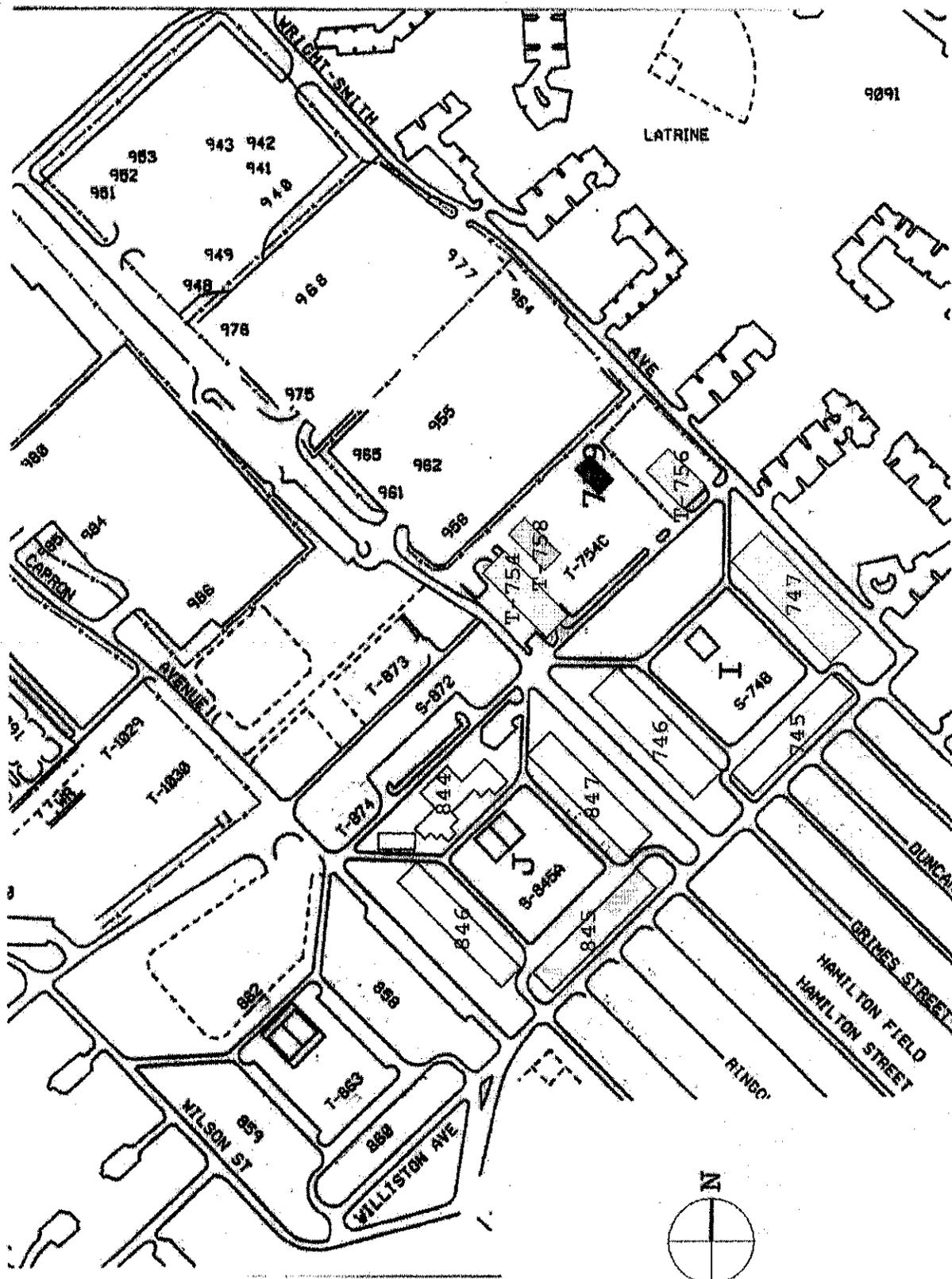
Building T-759 is an open front, motor pool building. The motor pool building is fenced in and there are two open storage buildings. One storage unit contains oxygen storage tanks and the other acetylene storage tanks. Testing is not required on the chain link fence at the storage units. This old motor pool building is not in use - it is slab on grade construction and built of prefabricated metal.

II. SUMMARY OF SURVEY

Based on the field survey, only one fixture type was detected at this building and it is described as follows:

Type "H": suspended fixture

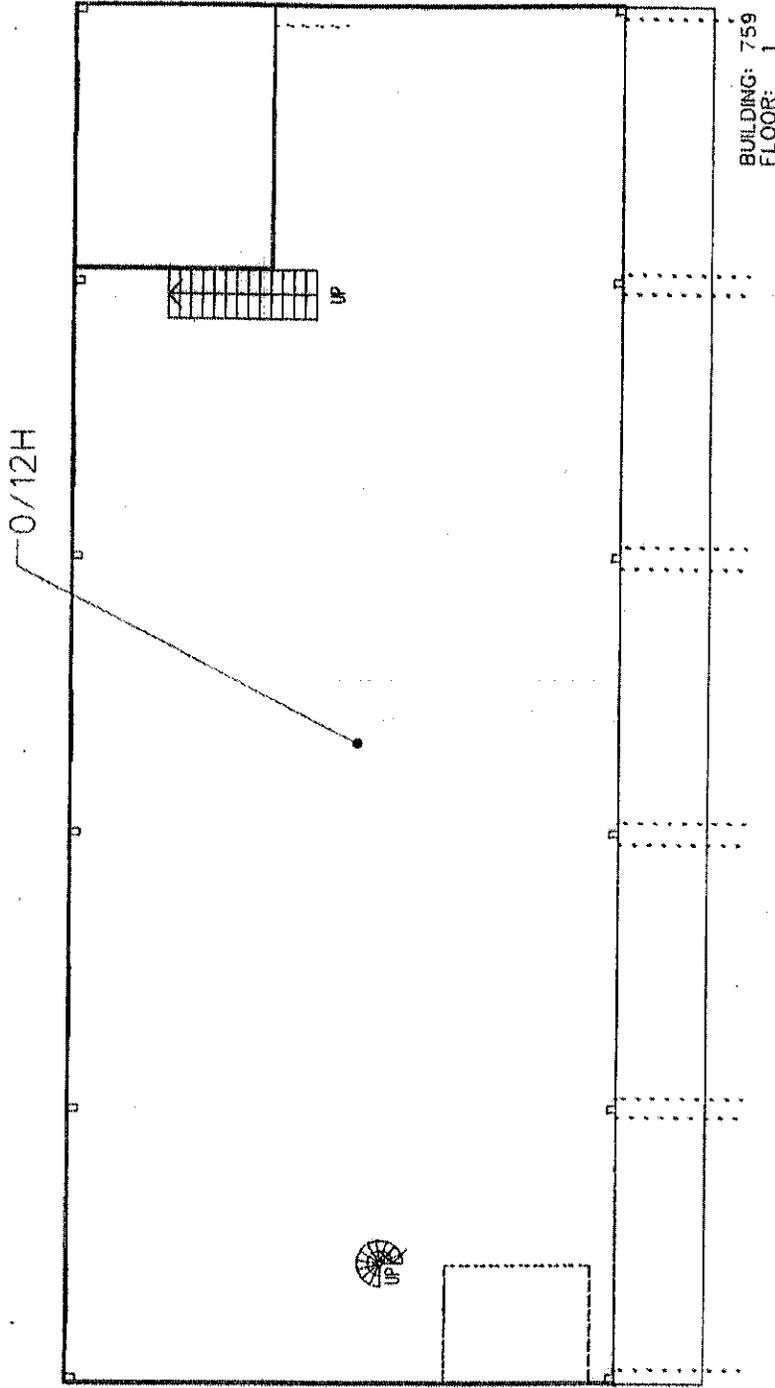
A total of 12 light fixtures were surveyed out of approximately 30 fixtures existing at Building T-759. No fixture was found to contain PCB light ballasts.



The Demolition Survey for Buildings 747, T-754, T-756, T-758, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DAC-AB3-00-D-0007, T.O. 0003

Sample Location Plan
 Building 759

FIGURE
 L-1



X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE INDICATES PRESENCE OF PCB BALLASTS



APPENDIX M

BUILDING 845

BUILDING 845

I. INTRODUCTION

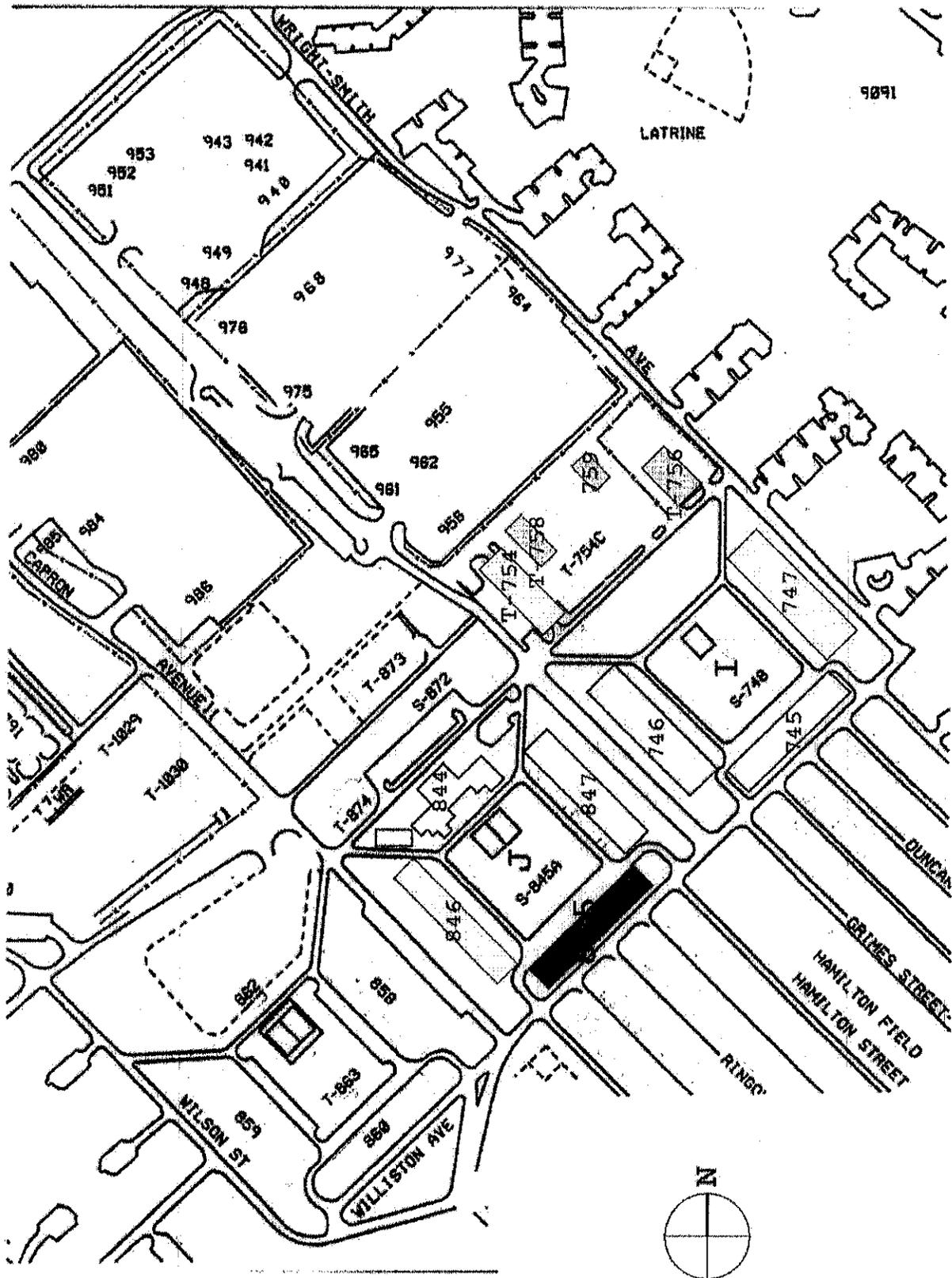
Building 845 is a WWII 3-story concrete structure. The first floor of each building is office space and the second and third floors are the soldiers living quarters.

II. SUMMARY OF SURVEY

Based on the field survey, only eight fixture types were detected at this building and they are described as follows:

- Type "A": 2-tube recessed ceiling fluorescent fixture
- Type "A1": 4-tube recessed ceiling fluorescent fixture
- Type "B": 1-tube surface mounted fluorescent fixture
- Type "C": 2-tube suspended fluorescent fixture
- Type "D": wall mounted corridor fixture
- Type "E": wall mounted stair fixture
- Type "F": exterior wall mounted fixture
- Type "G": suspended fixture

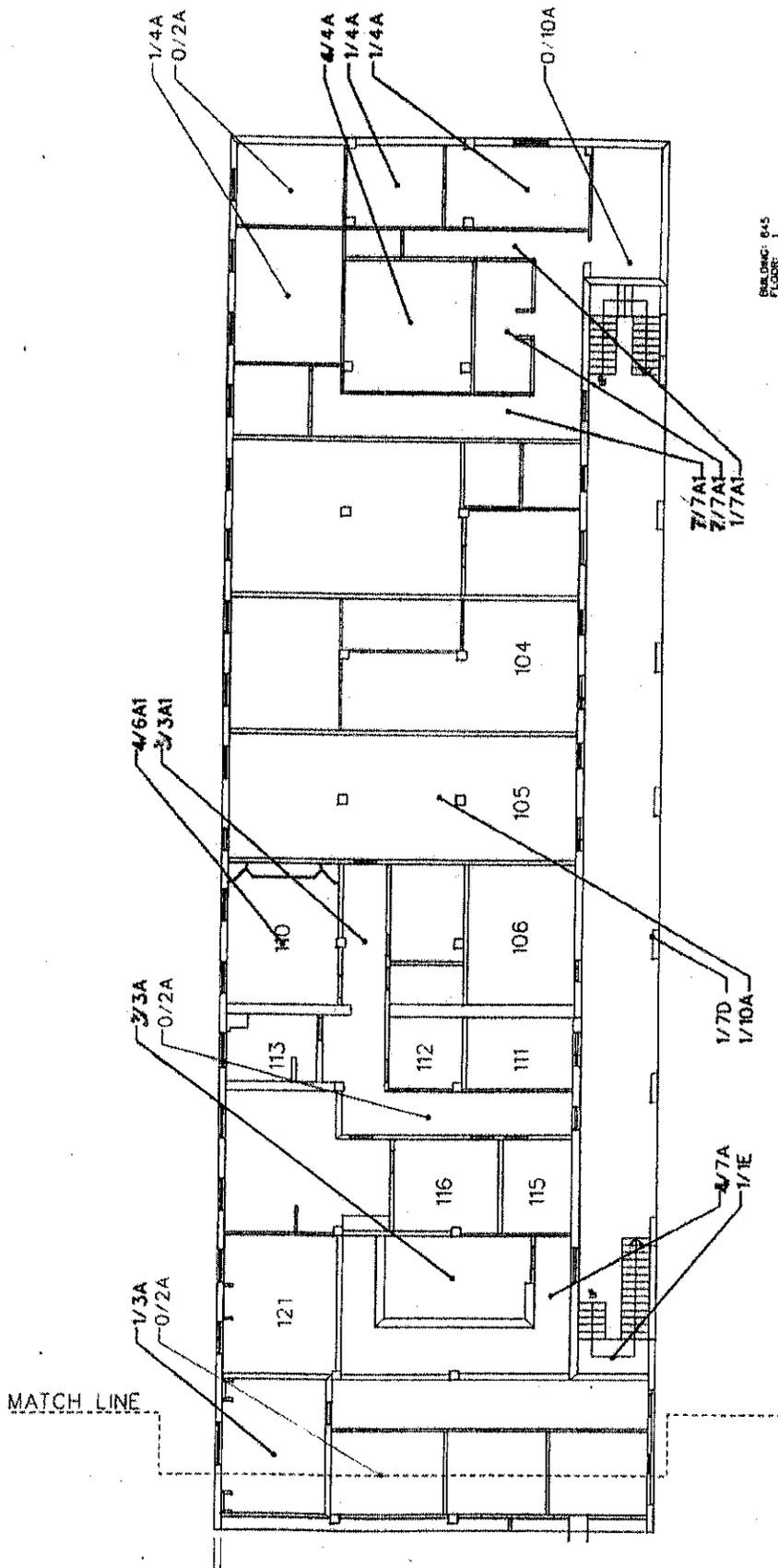
A total of 395 light fixtures were surveyed out of approximately 1,200 fixtures existing at Building 845 (This number of total fixtures is only an estimate, rooms not covered in the survey are assumed to contain similar number of fixtures as the adjacent rooms). Only 83 fixtures were found to contain PCB light ballasts which is equivalent to approximately 21% of the fixtures surveyed.



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 845

FIGURE
 M-1



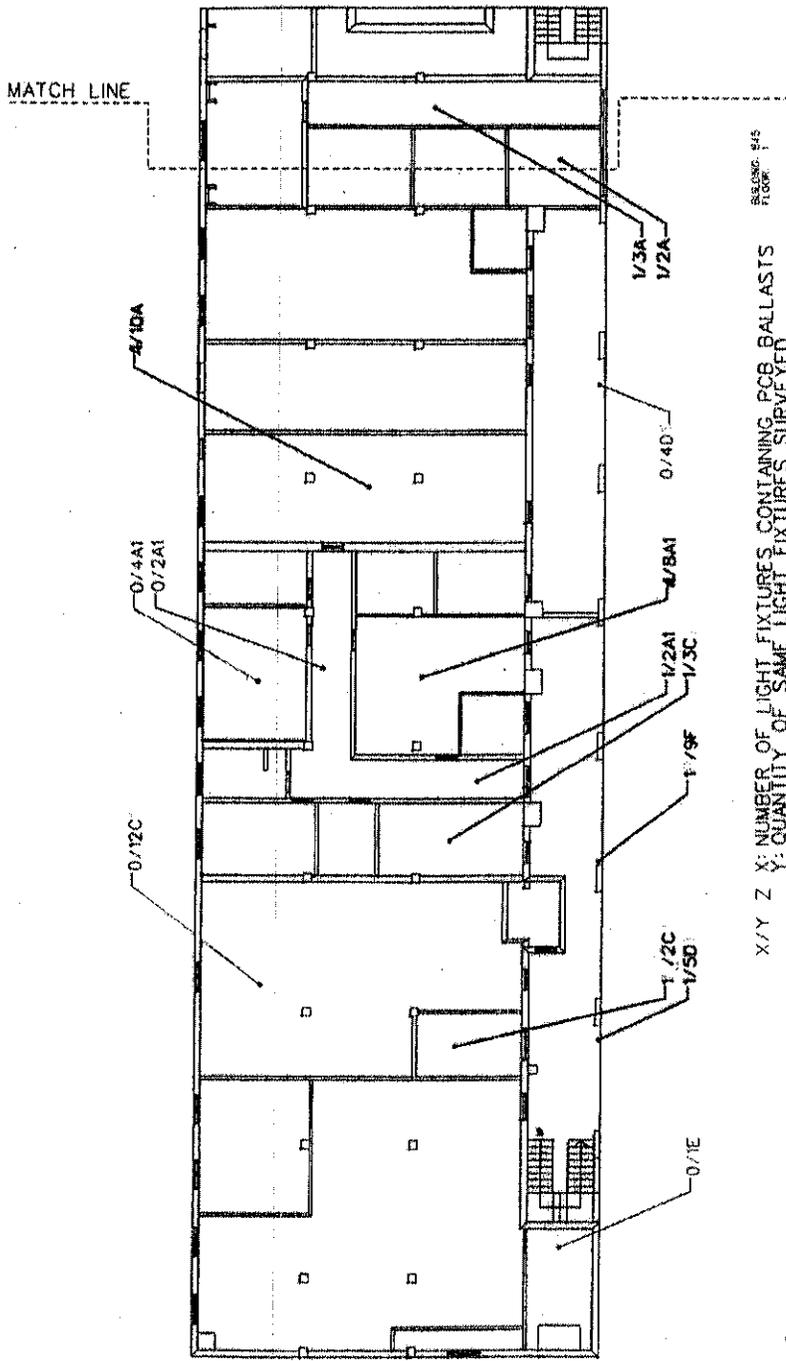
X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACA83-00-D-0007, T.O. 0003

Sample Location Plan
 Building 845

FIGURE M-2



X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURE TYPE SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

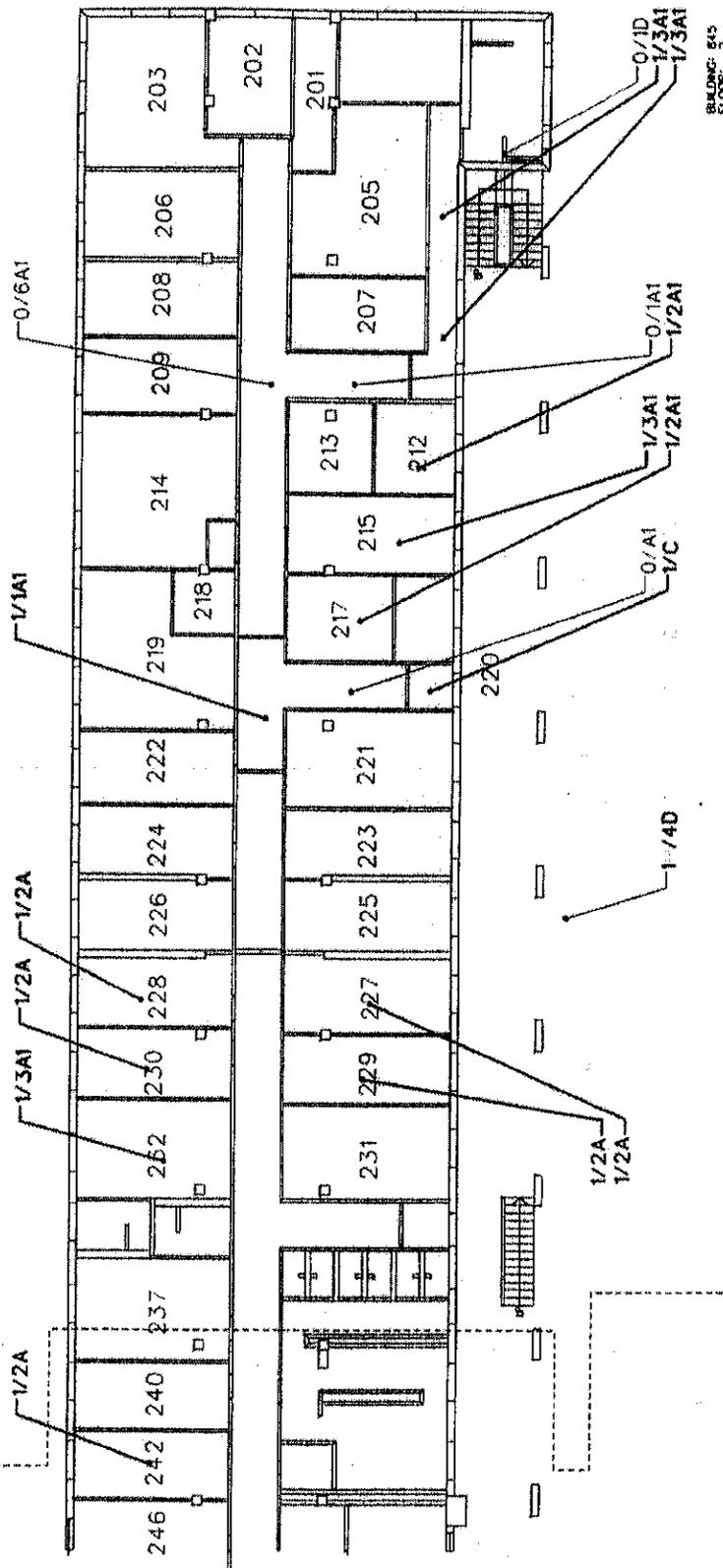


The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACAB3-00-D-0007, T.O. 0003

Sample Location Plan
 Building 845

FIGURE
M-3

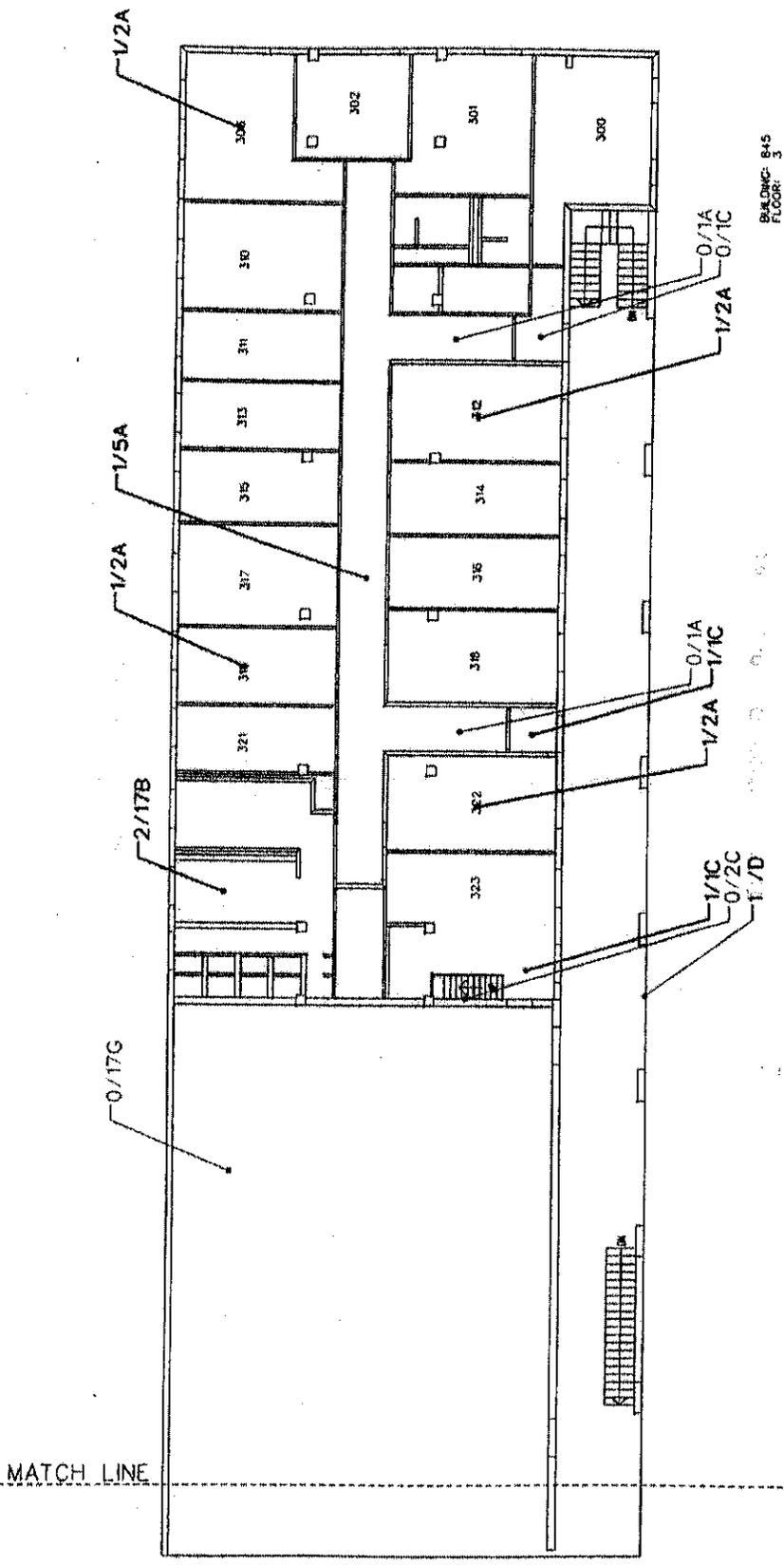
MATCH LINE



X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

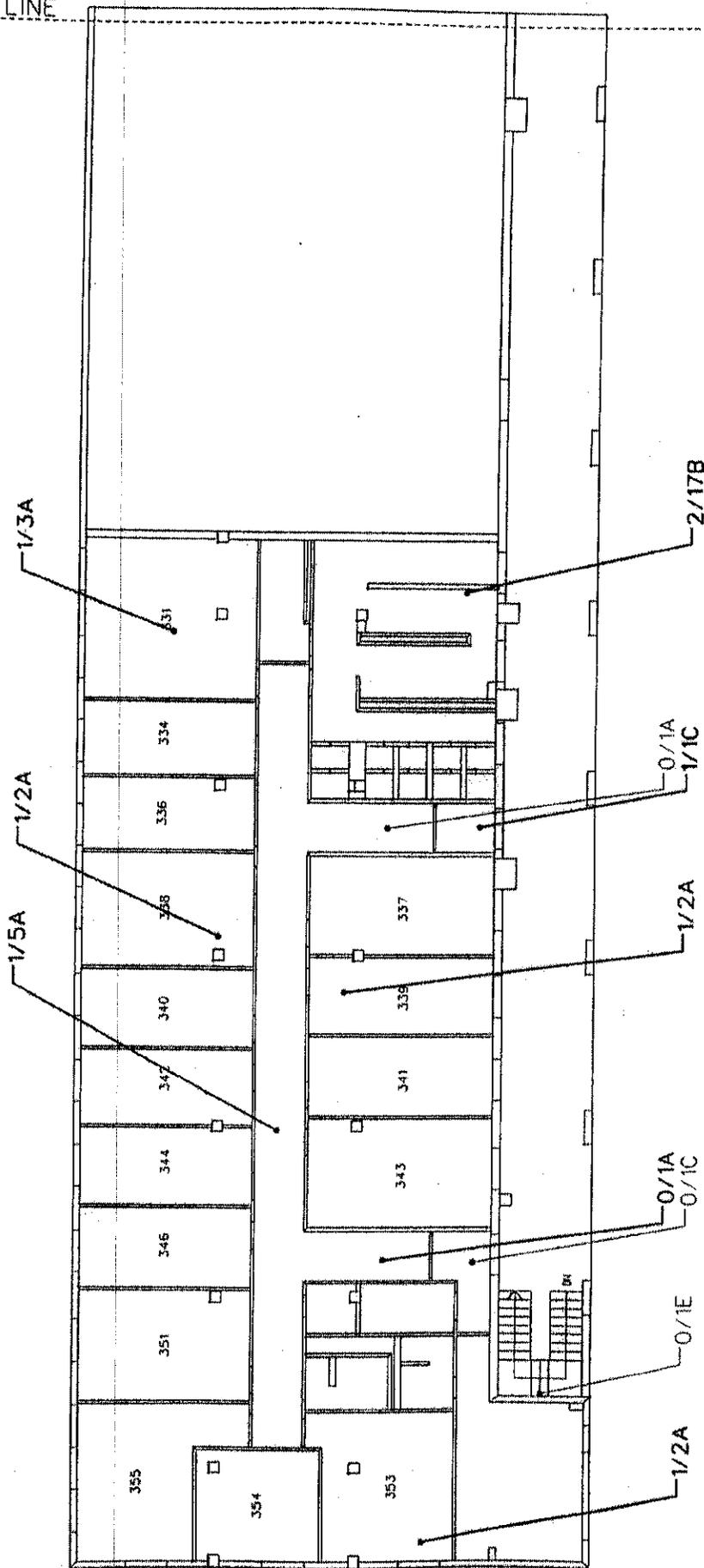




X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE
 NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS



MATCH LINE



BUILDING: 845
FLOOR: 3

X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

50 FT



APPENDIX N

BUILDING 846

BUILDING 846

I. INTRODUCTION

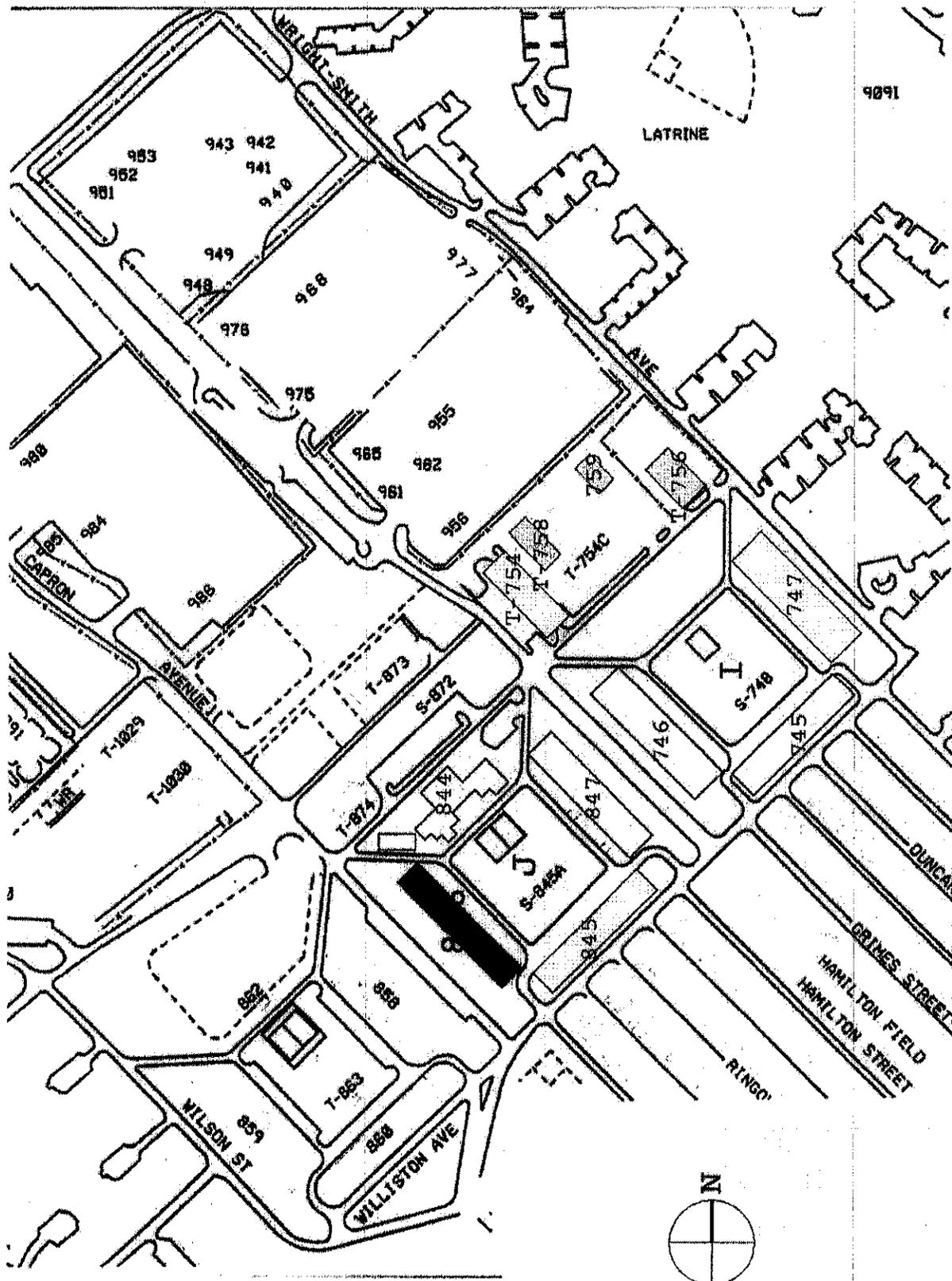
Building 846 is a WWII 3-story concrete structure. The first floor of each building is office space and the second and third floors are the soldiers living quarters.

II. SUMMARY OF SURVEY

Based on the field survey, only eight fixture types were detected at this building and they are described as follows:

- Type "A": 2-tube recessed ceiling fluorescent fixture
- Type "A1": 4-tube recessed ceiling fluorescent fixture
- Type "B": 1-tube surface mounted fluorescent fixture
- Type "C": 2-tube suspended fluorescent fixture
- Type "D": wall mounted corridor fixture
- Type "E": wall mounted stair fixture
- Type "F": exterior wall mounted fixture
- Type "G": suspended fixture

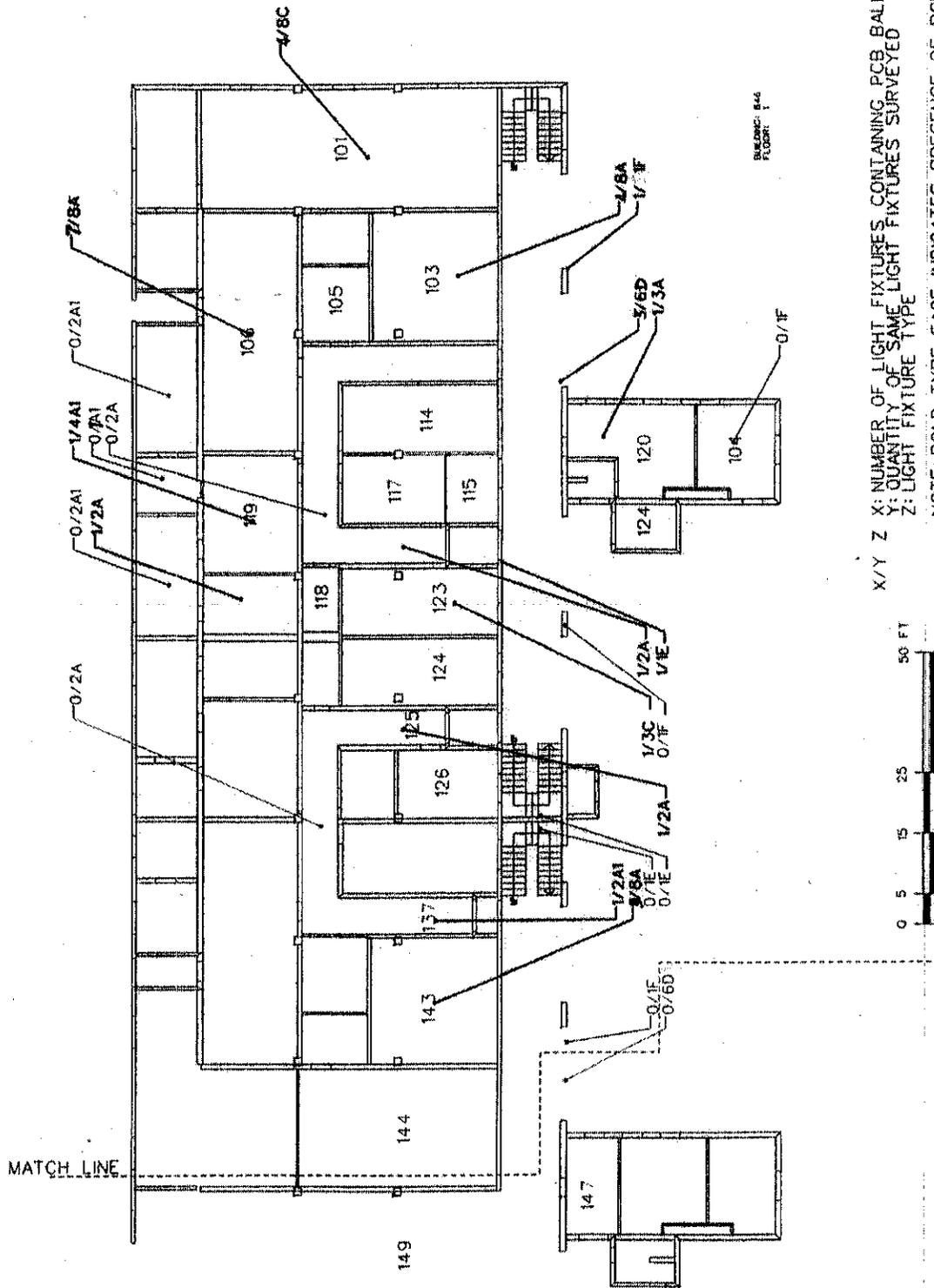
A total of 420 light fixtures were surveyed out of approximately 1,300 fixtures existing at Building 845 (This number of total fixtures is only an estimate, rooms not covered in the survey are assumed to contain similar number of fixtures as the adjacent rooms). Only 134 fixtures were found to contain PCB light ballasts which is equivalent to approximately 32% of the fixtures surveyed.



The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
 Schofield Barracks, Island of Oahu, Hawaii
 DACAB3-00-D-0007, T.O. 0003

Sample Location Plan
 Building 846

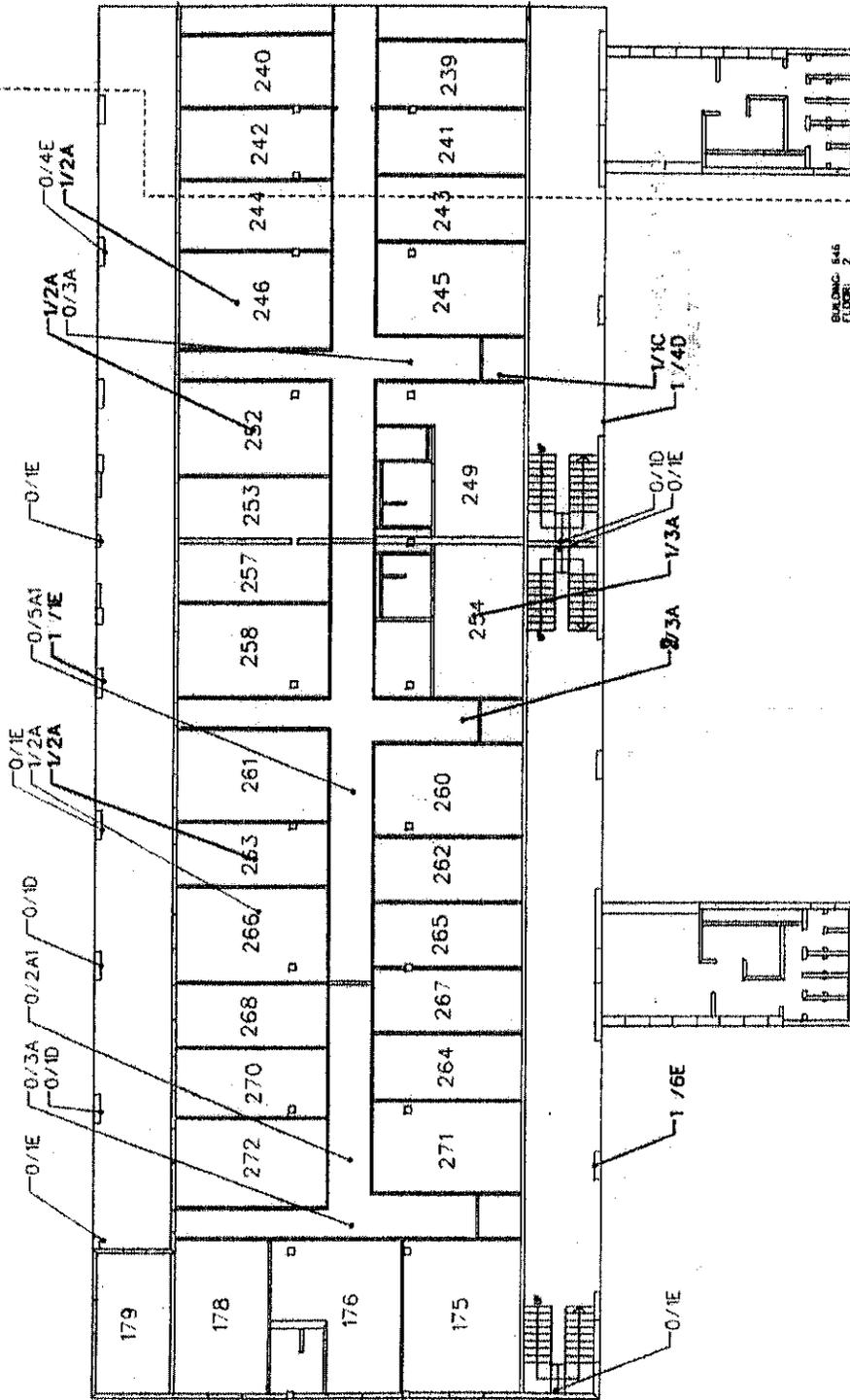
FIGURE
 N-1



X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
 Y: QUANTITY OF SAME LIGHT FIXTURE TYPE
 Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

MATCH LINE

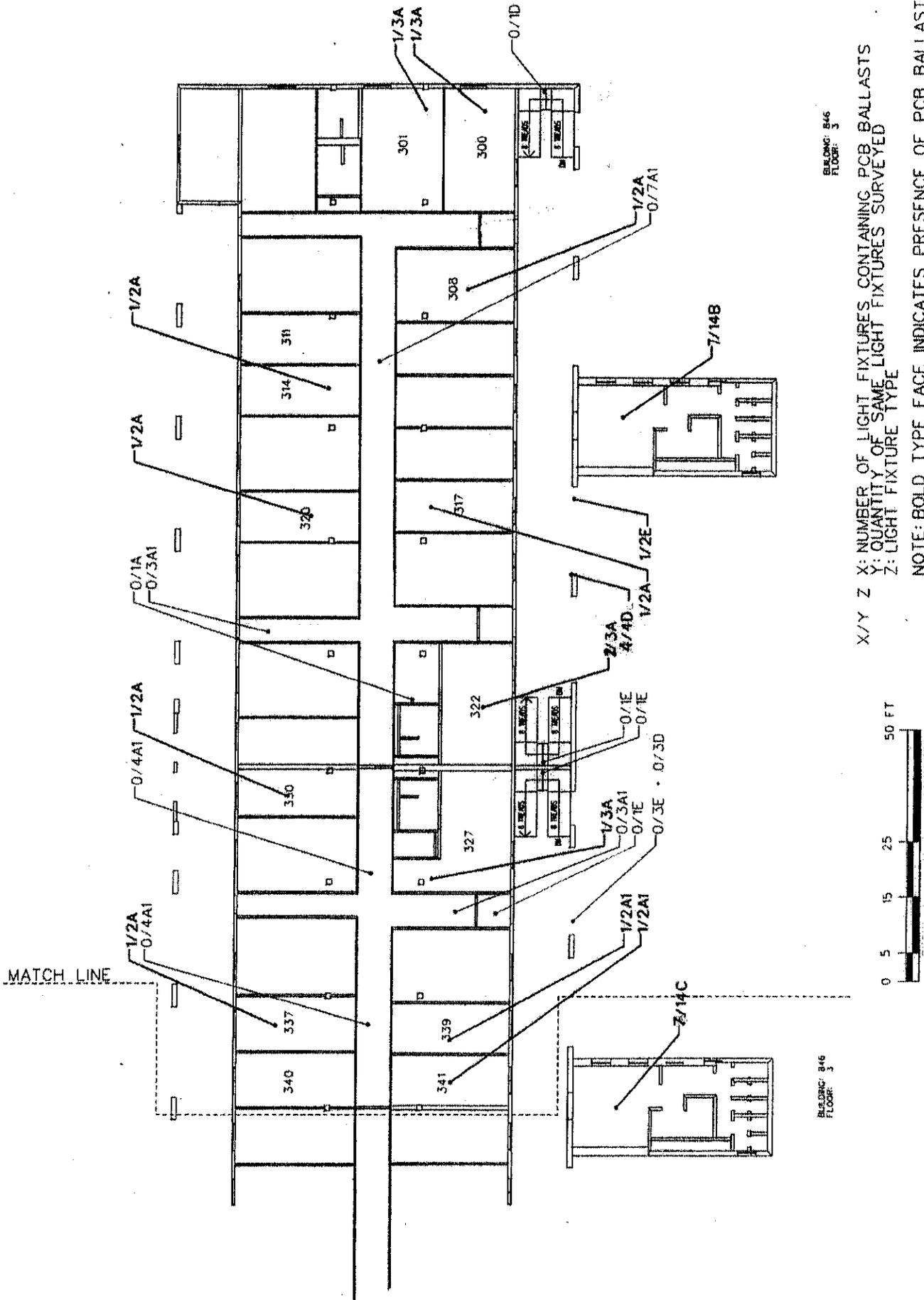


BUILDING 846
FLOOR 2

X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS





BUILDING: 846
FLOOR: 3

BUILDING: 846
FLOOR: 3

X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
Y: QUANTITY OF SAME LIGHT FIXTURES SURVEYED
Z: LIGHT FIXTURE TYPE

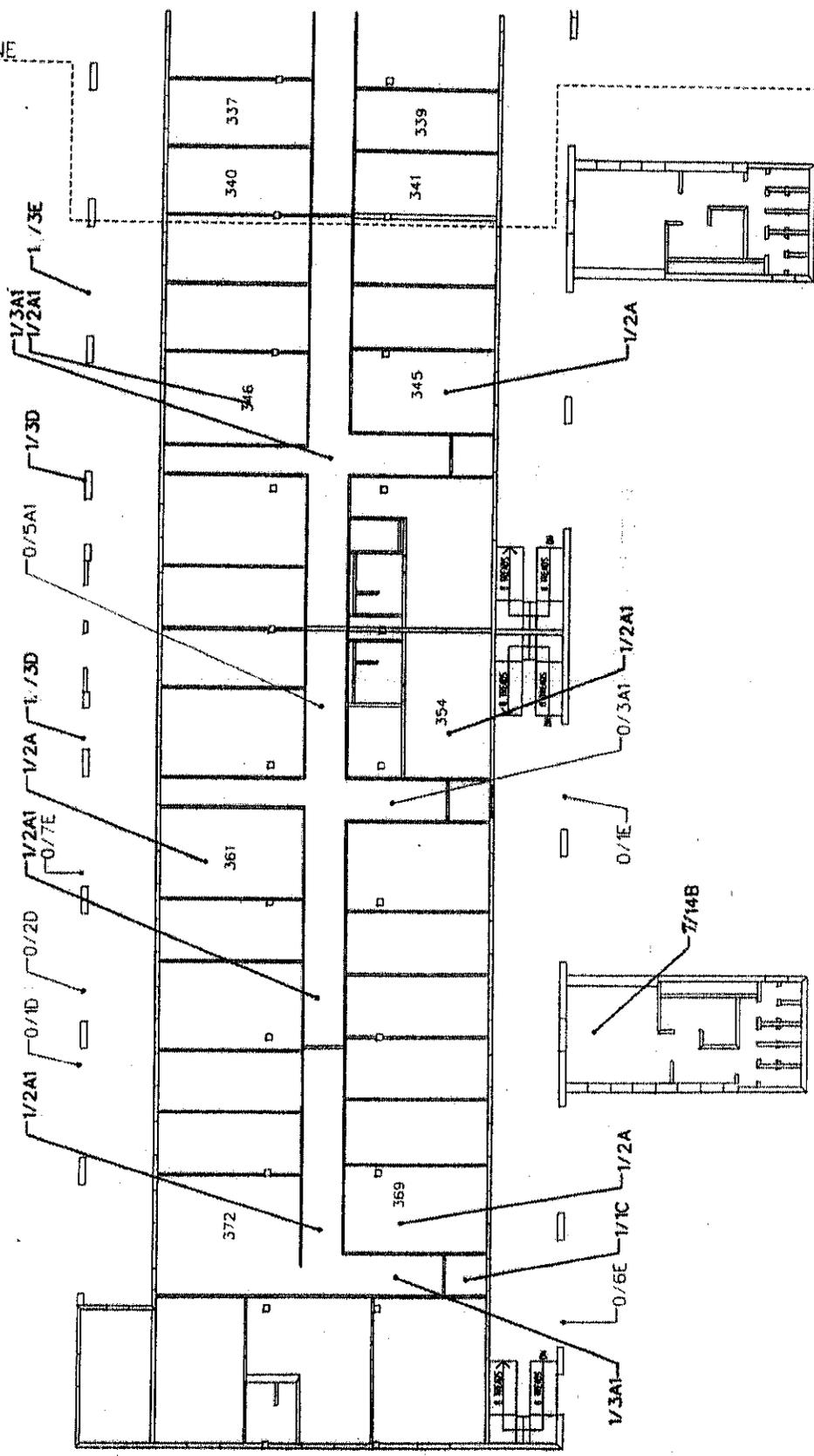
NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS

The Demolition Survey for Buildings 747, T-754, T-758, T-759, 845, and 846
Schofield Barracks, Island of Oahu, Hawaii
DACA83-00-D-0007, T.O. 0003

Sample Location Plan
Building 846

FIGURE
N-6

MATCH LINE



BUILDING: 846
FLOOR: 3

X/Y Z X: NUMBER OF LIGHT FIXTURES CONTAINING PCB BALLASTS
Y: QUANTITY OF SAME LIGHT FIXTURE TYPE SURVEYED
Z: LIGHT FIXTURE TYPE

NOTE: BOLD TYPE FACE INDICATES PRESENCE OF PCB BALLASTS



Part 2-B

UST Inspection Report

TABLE OF CONTENTS

I.	EXECUTIVE SUMMARY	1
II.	INTRODUCTION	1
III.	SURVEY METHODOLOGY	1
IV.	SURVEY FINDINGS	1
V.	DISCUSSIONS	2
VI.	RECOMMENDATIONS	2

I. EXECUTIVE SUMMARY

From the UST inspection, it appears that a complete removal of the Ust system has not been completed for Buildings 845, 846 and T-754 (if present). Since no fill ports were located, it is possible that the fuel oil tanks were removed along with the fill ports, while cutting all other associated UST system piping and abandoning them in place. It is also possible that the fill ports were simply removed and the fuel oil tanks abandoned in place. Extensive geophysical exploration or excavation would be required to determine if the tanks are still in place. To insure the complete closure of the fuel oil UST systems in Buildings 845, 846 and T-754 (if present), recommendation is that the first phase of the actual building demolition incorporate three stages to allow for UST system removal and closure. The first stage would consist of excavation of the UST piping system. If the piping leads to a tank, then stage two would consist of tank removal and soil/water sampling under the tank and supply piping. Stage three would consist of a UST closure report for each of the tanks removed in stage two.

II. INTRODUCTION

Buildings 845 and 846 of Quad J at Schofield Barracks contain boiler units which were formerly fired by fuel oil stored in underground storage tanks (UST). These units have since been upgraded to propane gas heating systems. Buildings T-754, T-756, T-758 and T-759 were not known to contain boiler units nor UST. The scope of work is to conduct a visual inspection of the buildings to determine if the USTs which stored heating oil for the boilers are still present, especially for buildings at the quad.

III. SURVEY METHODOLOGY

On July 19, 2000, Fung Associates performed an on-site inspection of Buildings 845, 846, T-754, T-756, T-758 and T-759 and surrounding areas extending to adjacent roadways, searching for any evidence that old heating oil USTs are still present. Field inspection concentrated in the existing boiler rooms and the adjacent areas.

IV. SURVEY FINDINGS

Building T-754 (Photo 1)

- Although no UST was purported to be known for this building, some exterior piping were observed in the grass area outside the building on the southwest side.
- No fill ports for UST were located.
- Location of these piping did not support any equipment room inside the building in the adjacent area.
- Although the evidence did not suggest the presence of UST, the unusual placement of these piping may deserve caution during demolition.

Building 845 (Photo 2 – 3)

- Existing boilers are fueled by propane gas.
- No fill ports for UST were located which indicates that the UST has been removed or abandoned in place.
- No disturbance of concrete or asphaltic concrete was noticed, i.e., patching about the right size and location to directly indicate that the UST has been removed.

Building 846 (Photo 4 – 5)

- Existing boilers are fueled by propane gas.
- No fill ports for UST were located which indicates that the UST has been removed or abandoned in place.
- No disturbance of concrete or asphaltic concrete was noticed, i.e., patching about the right size and location to directly indicate that the UST has been removed.

V. DISCUSSIONS

From the UST inspection, it appears that a complete removal of the UST system has not been completed. Since no fill ports were located, it is possible that the fuel oil tanks were removed along with the fill ports, while cutting all other associated UST system piping and abandoning them in place. It is also possible that the fill ports were simply removed and the fuel oil tanks abandoned in place. Extensive geophysical exploration or excavation would be required to determine if the tanks are still in place.

VI. RECOMMENDATIONS

To insure the complete closure of the fuel oil UST systems in Buildings 845, 846 and T-754 (if present), recommendation is that the first phase of the actual building demolition incorporate three stages to allow for UST system removal and closure. The first stage would consist of excavation of the UST piping system. If the piping leads to a tank, then stage two would consist of tank removal and soil/water sampling under the tank and supply piping. Stage three would consist of a UST closure report for each of the tanks removed in stage two.

Photo 1: Building T-754 Exterior Piping

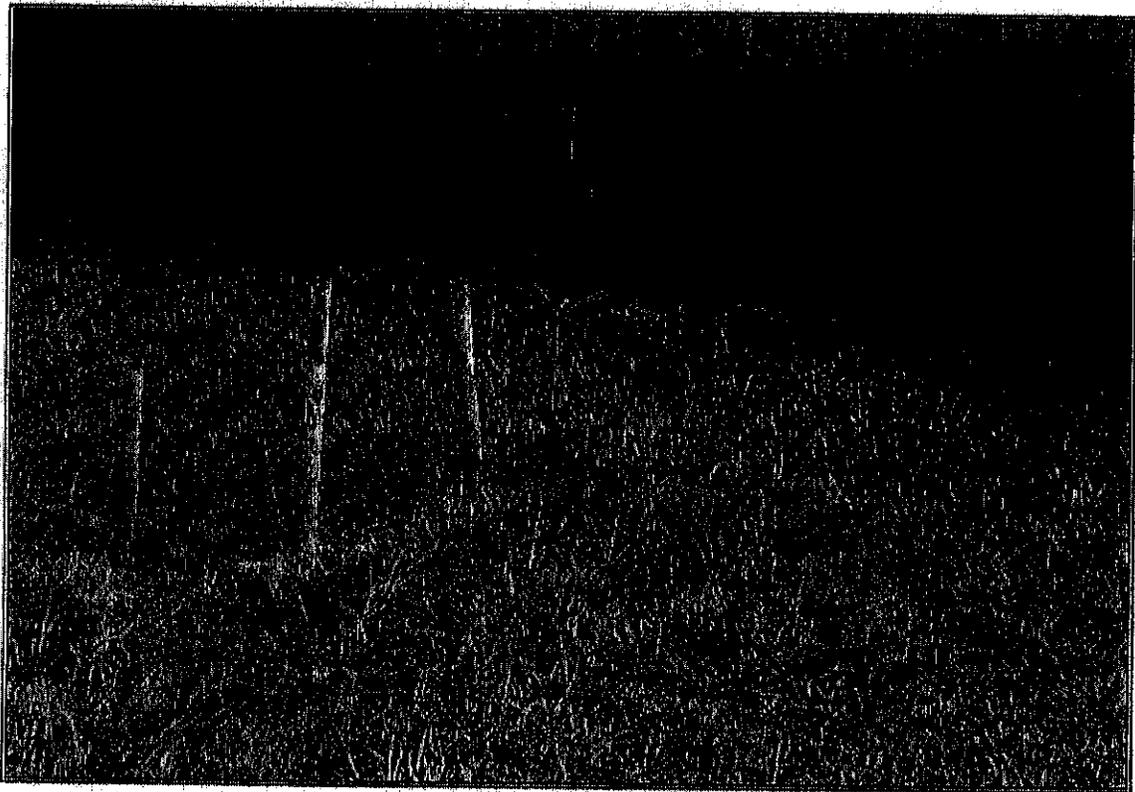


Photo 2: Building 845 Boiler Room

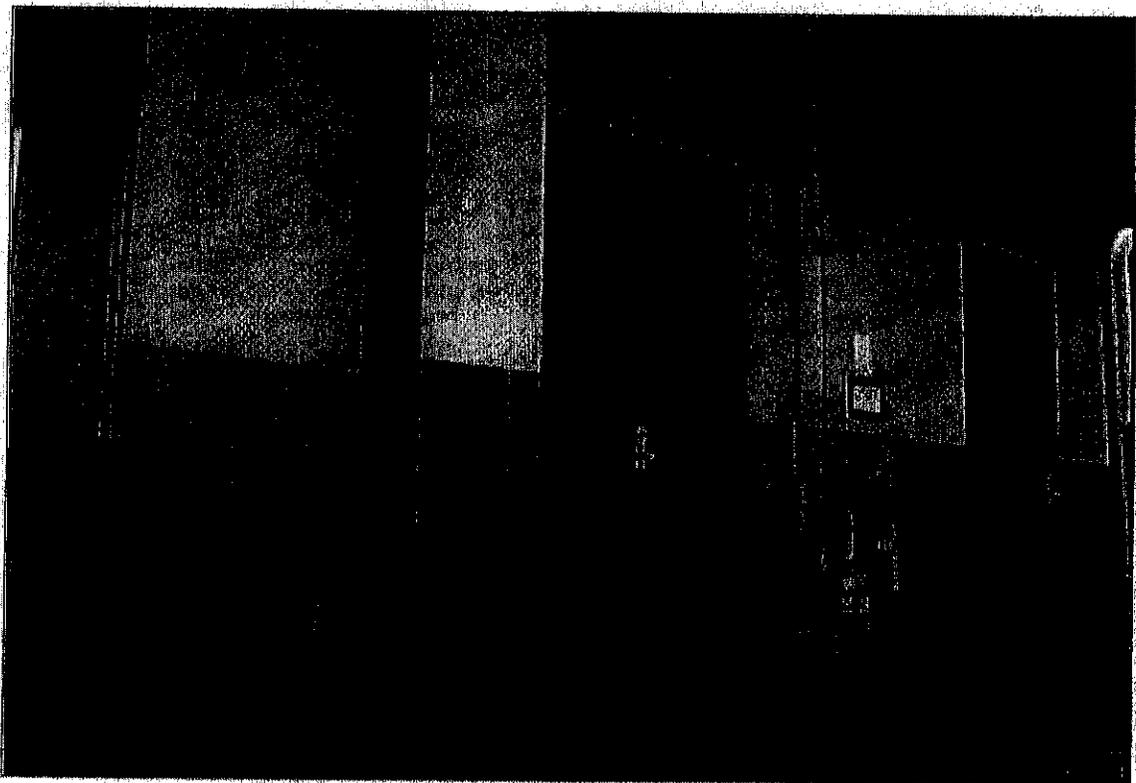


Photo 3: Building 845 Propane Gas Heater

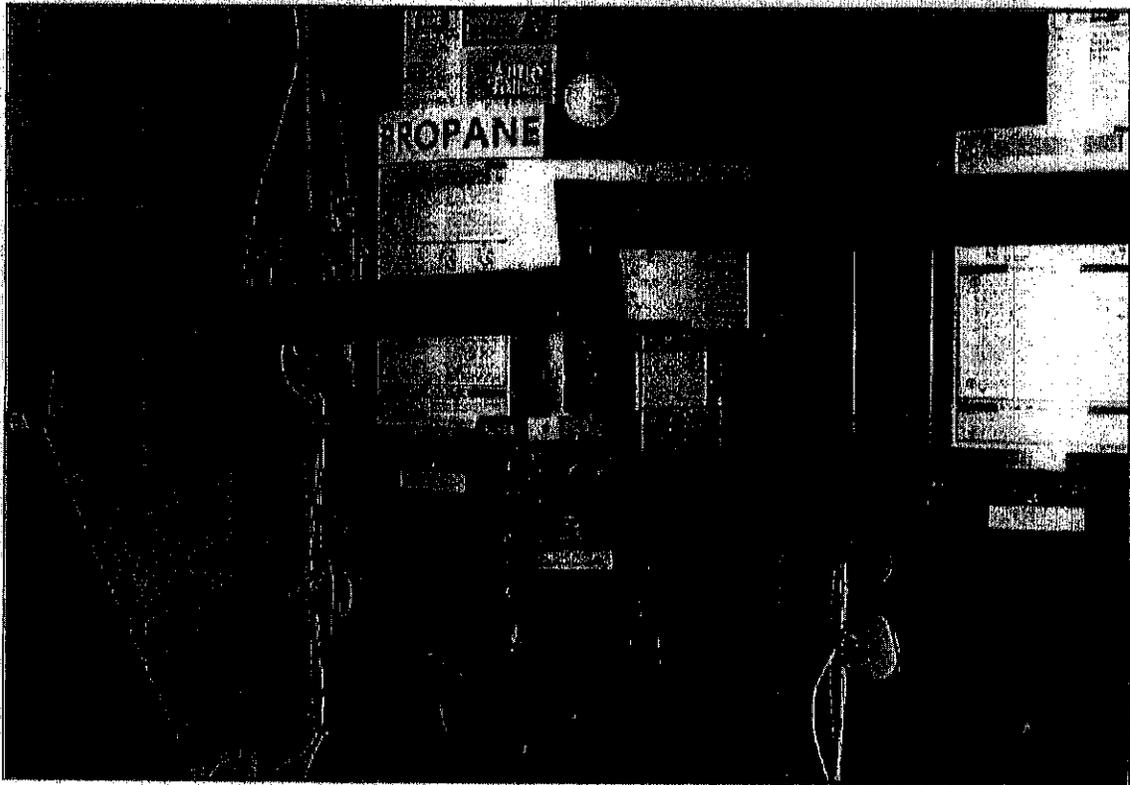


Photo 4: Building 846 Boiler Room

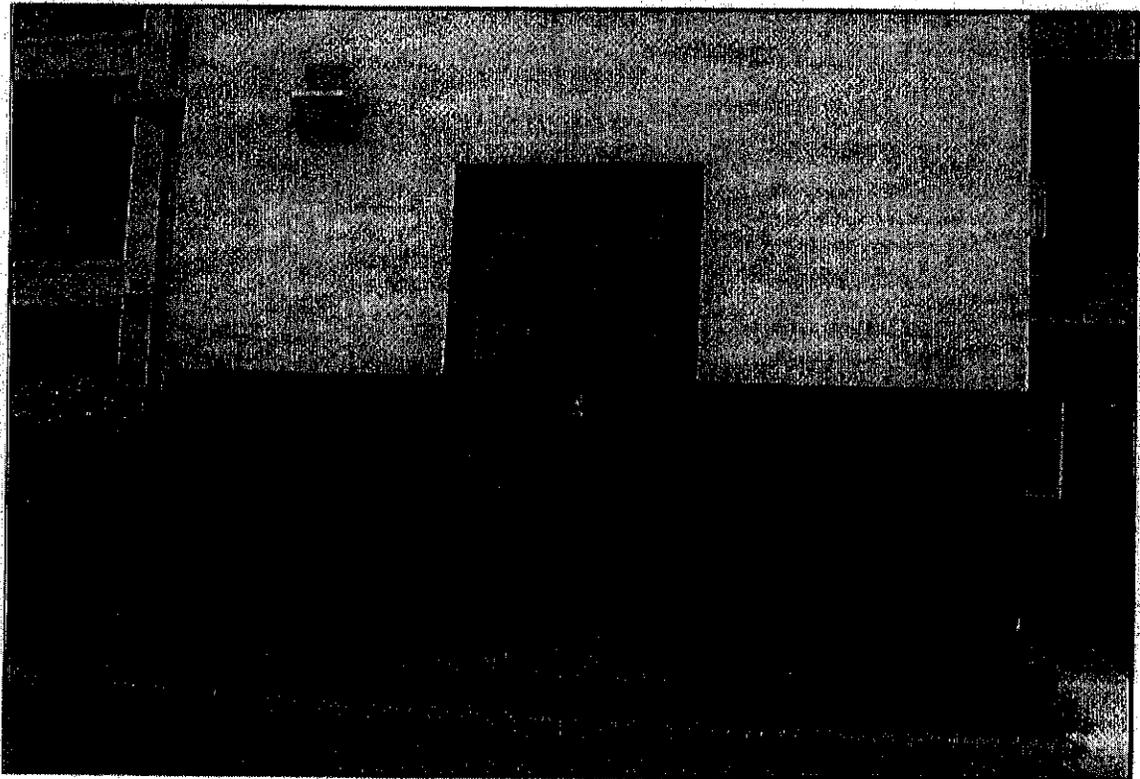
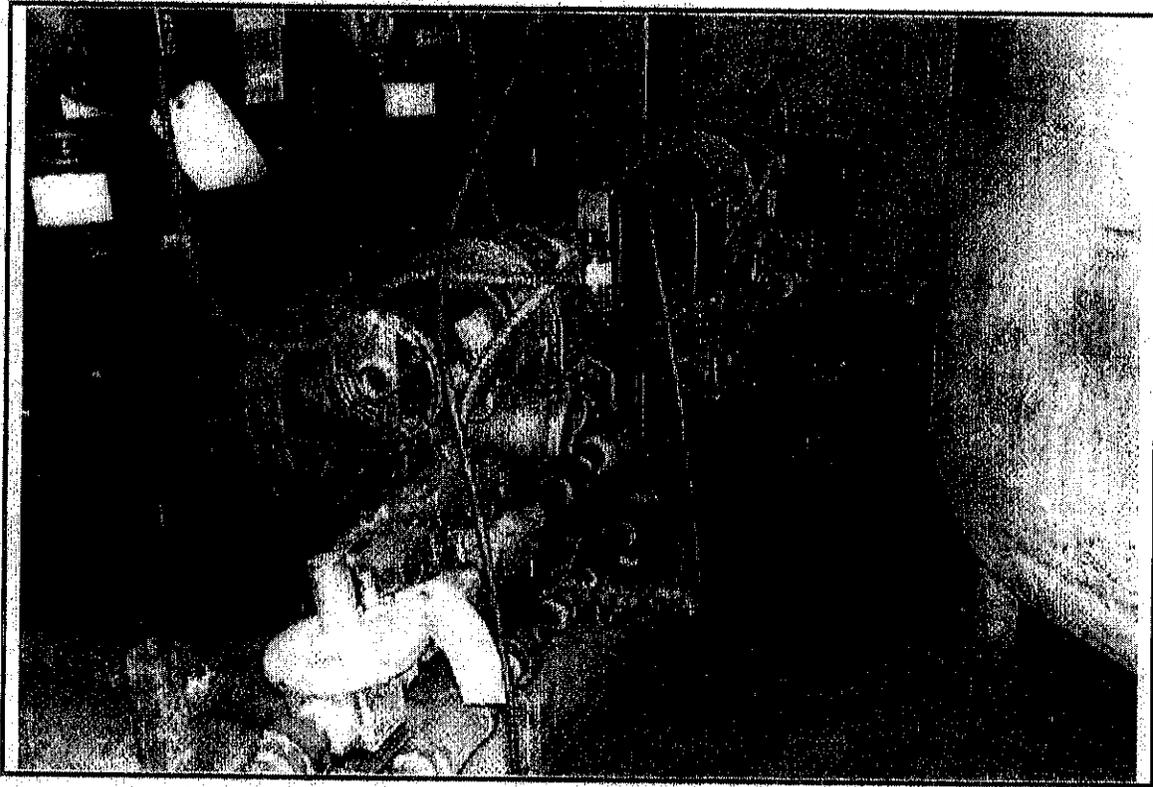
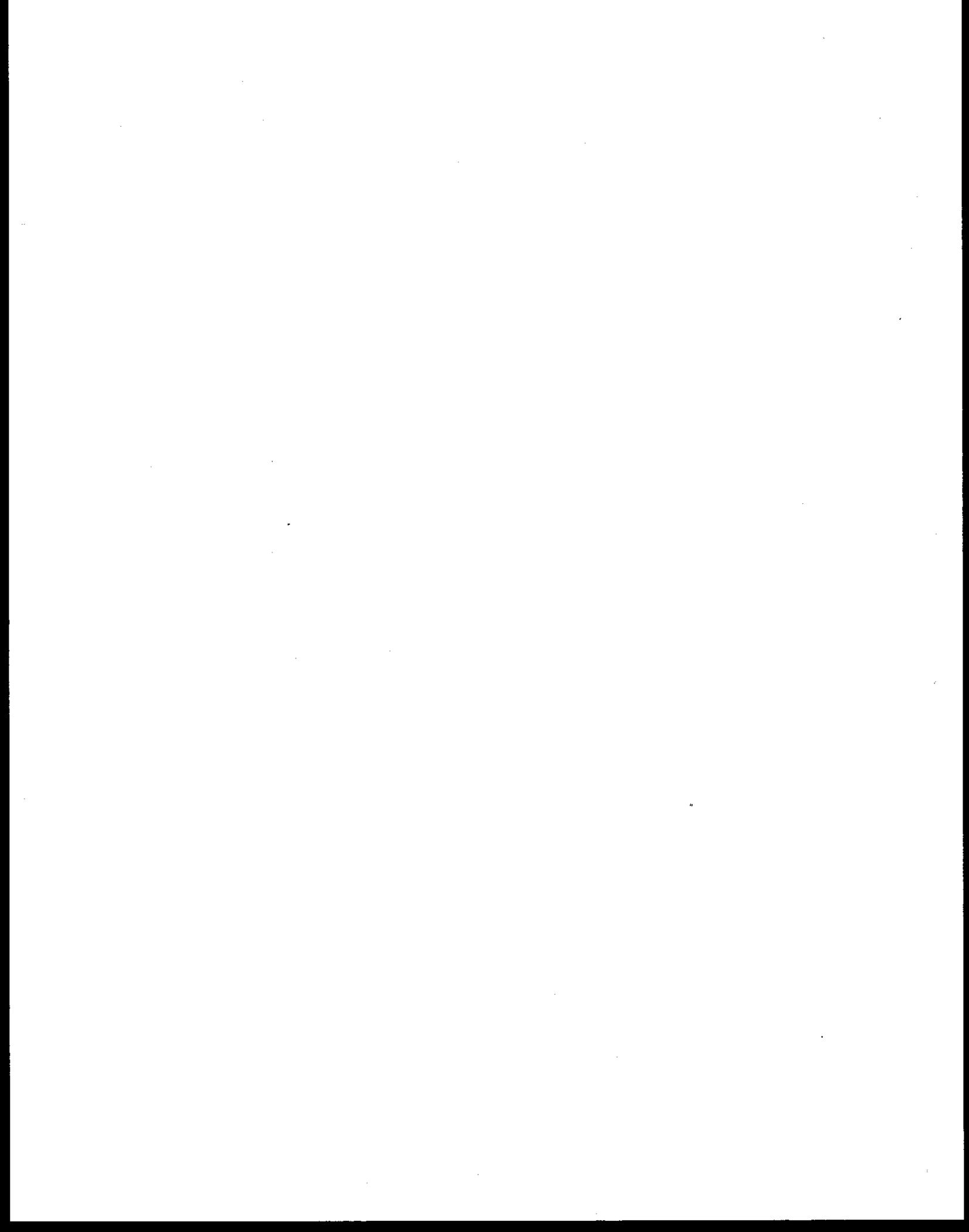


Photo 5: Building 846 Propane Gas Heater





Tel: 206.547.0100
Fax: 206.634.1936

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

LAYER 1: *None Detected ND
LAYER 2: Chrysotile 4%

Lab ID #: 20076617 Client Sample #: 2177-845-031

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray vinyl tile, LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076618 Client Sample #: 2177-845-032

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Gray vinyl tile, LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf Khan

Date: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076619 Client Sample #: 2177-845-033

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Black vinyl tile, LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076620 Client Sample #: 2177-845-034

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Black vinyl tile, LAYER 2: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076621 Client Sample #: 2177-845-035

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Tan mastic, LAYER 2: Gray vinyl tile, LAYER 3: Black mastic, LAYER 4: Brown mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 1%, Synthetic fiber 1%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 1%
LAYER 4: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Adhesive/binder, Mineral debris
LAYER 2: Vinyl/binder, Mineral debris
LAYER 3: Asphalt/binder, Mineral debris
LAYER 4: Adhesive/binder, Mineral debris

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%
LAYER 4: *None Detected	ND

Lab ID #: 20076622 Client Sample #: 2177-845-036

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Tan mastic, LAYER 2: Gray vinyl tile, LAYER 3: Black mastic, LAYER 4: Brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 1%, Synthetic fiber 1%
LAYER 2: Cellulose 2%
LAYER 3: Cellulose 1%
LAYER 4: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Adhesive/binder, Mineral debris
LAYER 2: Vinyl/binder, Mineral debris
LAYER 3: Asphalt/binder, Mineral debris
LAYER 4: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	4%
LAYER 4: *None Detected	ND

Lab ID #: 20076623 Client Sample #: 2177-845-037

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Green vinyl tile, LAYER 2: Amber-colored adhesive

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Date: 08/04/2000

Reviewed by: Munaf Khan

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Pikoi Street, Suite 300
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Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076624 Client Sample #: 2177-845-038

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Green vinyl tile, LAYER 2: Amber-colored adhesive

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076625 Client Sample #: 2177-845-039

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Red vinyl tile, LAYER 2: Amber-colored adhesive

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076626 Client Sample #: 2177-845-040

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Red vinyl tile, LAYER 2: Amber-colored adhesive

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Adhesive/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn: Mr. William Harris
Project: Quad I and J, Schofield

NVL Batch Number: 00-09927.00

Client Project #: 09927
Number of samples: 47LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076627 Client Sample #: 2177-845-041

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Brown vinyl tile, LAYER 2: Black mastic**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Mineral/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	4%

Lab ID #: 20076628 Client Sample #: 2177-845-042

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Red-brown vinyl material, LAYER 2: White mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Date: 08/04/2000

Reviewed by: Munaf Khan

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47

Lab ID #: 20076629 Client Sample #: 2177-845-043

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl material, LAYER 2: Tan mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076630 Client Sample #: 2177-845-044

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl material, LAYER 2: Tan mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076631 Client Sample #: 2177-845-045

Sample Location: Quad I and J, Schofield

Description: LAYER 1: Brown vinyl material with painted surface, LAYER 2: Tan mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Paint
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: John Terrill

Reviewed by: Munaf Khan

Date: 08/04/2000

Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad I and J, SchofieldNVL Batch Number: 00-09927.00
Client Project #: 09927
Number of samples: 47LAYER 1: *None detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076632 Client Sample #: 2177-845-046

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Brown vinyl material, LAYER 2: Tan mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076633 Client Sample #: 2177-845-047

Sample Location: Quad I and J, Schofield
Description: LAYER 1: Brown vinyl material, LAYER 2: Tan mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder
LAYER 2: Asphalt/binder, Mineral debris

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Sampled by: Client
Analyzed by: John Terrill
Reviewed by: Munaf KhanDate: 08/04/2000
Date: 08/04/2000

Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076634 Client Sample #: 2177-845-048

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown rubbery material LAYER 2: White soft calcareous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076635 Client Sample #: 2177-845-049

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown rubbery material LAYER 2: White soft calcareous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076636 Client Sample #: 2177-845-050

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

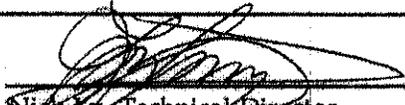
NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076637 Client Sample #: 2177-845-051

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20076638 Client Sample #: 2177-845-052

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

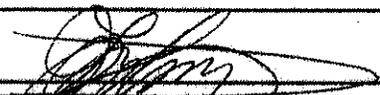
ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076639 Client Sample #: 2177-845-053

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic LAYER 3: Brown brittle mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder
LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076640 Client Sample #: 2177-845-054

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic LAYER 3: Gray fibrous material

OTHER FIBROUS MATERIALS:

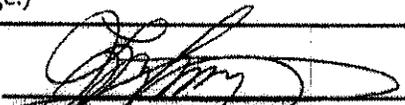
LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 65%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
LAYER 2: Mastic/binder
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/04/2000	
Analyzed by: Steve Zhang	Date: 08/04/2000	
Reviewed by: Nick Ly	Date: 08/04/2000	

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076641 Client Sample #: 2177-845-055

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076642 Client Sample #: 2177-845-056

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Black rubbery material LAYER 2: White soft mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076643 Client Sample #: 2177-845-057

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

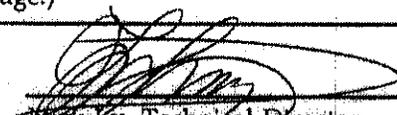
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

LAYER 1:	*None Detected	ND
LAYER 2:	*None Detected	ND
LAYER 3:	*None Detected	ND

Lab ID #: 20076644 Client Sample #: 2177-845-058

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076645 Client Sample #: 2177-845-059

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

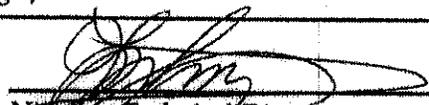
LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1.9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076646

Client Sample #: 2177-845-060

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 5%, Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix

LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

Lab ID #: 20076647

Client Sample #: 2177-845-061

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix

LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

(Sample results are continued on the next page.)

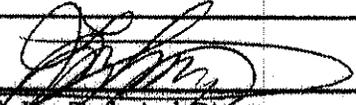
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076648 Client Sample #: 2177-845-062

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076649 Client Sample #: 2177-845-063

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

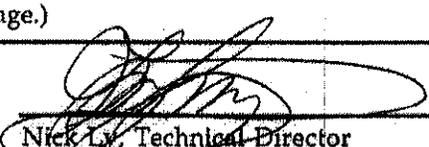
LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076650 Client Sample #: 2177-845-064

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076651 Client Sample #: 2177-845-065

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

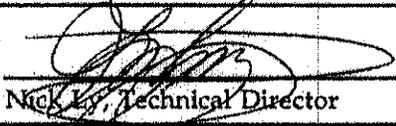
LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/04/2000	
Analyzed by: Steve Zhang	Date: 08/04/2000	
Reviewed by: Nick Ly	Nick Ly, Technical Director	

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076652 Client Sample #: 2177-845-066

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076653 Client Sample #: 2177-845-067

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%
 LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

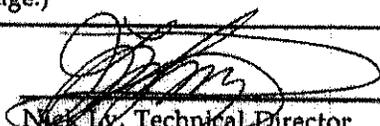
LAYER 1: Paint
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076654 Client Sample #: 2177-845-068

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20076655 Client Sample #: 2177-845-069

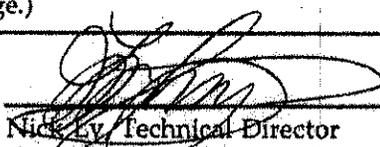
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 5%, Glass fibers 25%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Calcareous matrix
LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/04/2000
Date: 08/04/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Pilko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076656

Client Sample #: 2177-845-070

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 5%, Glass fibers 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix

LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

Lab ID #: 20076657

Client Sample #: 2177-845-071

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Tan paint LAYER 2: White fine grained calcareous matrix LAYER 3: Brown paper with white chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix

LAYER 3: Fine particles, Calcareous matrix

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076658 Client Sample #: 2177-845-072
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	<1%
LAYER 2: *None Detected	ND

Lab ID #: 20076659 Client Sample #: 2177-845-073
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

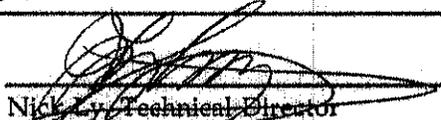
Lab ID #: 20076660 Client Sample #: 2177-845-074
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Grey paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
-----------------------	----------------

(Sample results are continued on the next page.)

Sampled by: Client	Date: 08/04/2000	
Analyzed by: Steve Zhang	Date: 08/04/2000	
Reviewed by: Nick Ly	Nick Ly, Technical Director	

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20076661

Client Sample #: 2177-845-075

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Grey paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20076662

Client Sample #: 2177-845-076

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

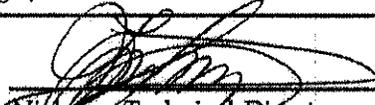
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076663 Client Sample #: 2177-845-077

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Grey/green paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076664 Client Sample #: 2177-845-078

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076665 Client Sample #: 2177-845-079

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

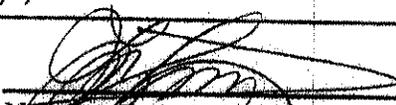
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076666 Client Sample #: 2177-845-080

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Sands

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076667 Client Sample #: 2177-845-081

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Grey/green paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 20076668 Client Sample #: 2177-845-082

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Sands

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076669 Client Sample #: 2177-845-083
 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20076670 Client Sample #: 2177-845-084
 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20076671 Client Sample #: 2177-845-085
 Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

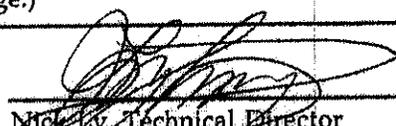
LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20076672 Client Sample #: 2177-845-086

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: LAYER 1: Beige paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 20076673 Client Sample #: 2177-845-087

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
 *None Detected ND

Lab ID #: 20076674 Client Sample #: 2177-845-088

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:

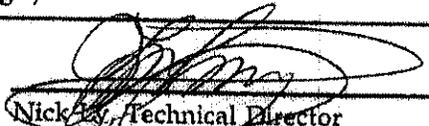
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

*None Detected ND

Lab ID #: 20076675 Client Sample #: 2177-845-089

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
*None Detected ND

Lab ID #: 20076676 Client Sample #: 2177-845-090

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
*None Detected ND

Lab ID #: 20076677 Client Sample #: 2177-845-091

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

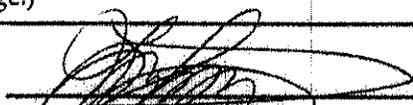
NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
*None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 3%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076678 Client Sample #: 2177-845-092

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite
PERCENT
ND

Lab ID #: 20076679 Client Sample #: 2177-845-093

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 4%, Glass fibers 45%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Glass beads
PERCENT
ND

Lab ID #: 20076680 Client Sample #: 2177-845-094

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 4%, Glass fibers 45%

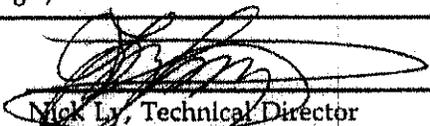
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Glass beads
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

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Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, SchofieldNVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076681 Client Sample #: 2177-845-095

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076683 Client Sample #: 2177-845-097

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076684 Client Sample #: 2177-845-098

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

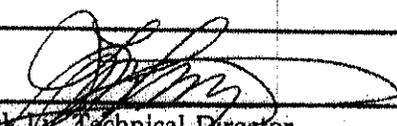
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

NVLAP
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Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076685 Client Sample #: 2177-845-099

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite
PERCENT
ND

Lab ID #: 20076687 Client Sample #: 2177-845-101

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite
PERCENT
ND

Lab ID #: 20076688 Client Sample #: 2177-845-102

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

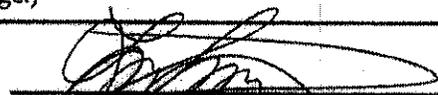
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076689 Client Sample #: 2177-845-103

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076690 Client Sample #: 2177-845-104

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076691 Client Sample #: 2177-845-105

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

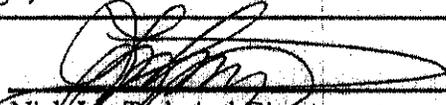
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076692 Client Sample #: 2177-845-106

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076693 Client Sample #: 2177-845-107

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076694 Client Sample #: 2177-845-108

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

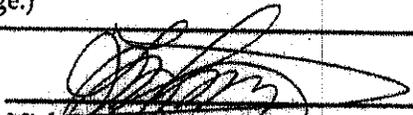
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076695 Client Sample #: 2177-845-109

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076696 Client Sample #: 2177-845-110

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076697 Client Sample #: 2177-845-111

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

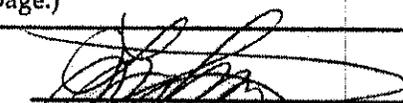
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076698 Client Sample #: 2177-845-112

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076699 Client Sample #: 2177-845-113

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076700 Client Sample #: 2177-845-114

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/04/2000
 Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Lab ID #: 20081067

Client Sample #: 2177-845-115

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081068

Client Sample #: 2177-845-116

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081069

Client Sample #: 2177-845-117

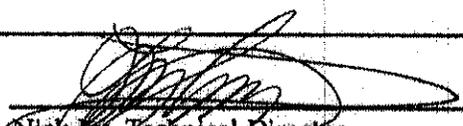
Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076669 Client Sample #: 2177-845-083
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076670 Client Sample #: 2177-845-084
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Brown paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20076671 Client Sample #: 2177-845-085
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: LAYER 1: Beige paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client		
Analyzed by: Steve Zhang	Date: 08/04/2000	 Nick Ly, Technical Director
Reviewed by: Nick Ly	Date: 08/04/2000	

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20076672 Client Sample #: 2177-845-086

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: LAYER 1: Beige paint LAYER 2: Grey granular/sandy material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Calcareous matrix, Sands

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20076673 Client Sample #: 2177-845-087

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT

*None Detected ND

Lab ID #: 20076674 Client Sample #: 2177-845-088

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

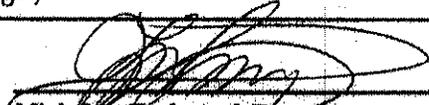
ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936

NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

***None Detected ND**

Lab ID #: 20076675 Client Sample #: 2177-845-089
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
***None Detected ND**

Lab ID #: 20076676 Client Sample #: 2177-845-090
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
***None Detected ND**

Lab ID #: 20076677 Client Sample #: 2177-845-091
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 10%

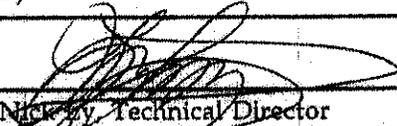
NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE: PERCENT
***None Detected ND**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076678 Client Sample #: 2177-845-092

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076679 Client Sample #: 2177-845-093

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 45%

NON-FIBROUS MATERIALS:

Calcareous matrix, Glass beads

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076680 Client Sample #: 2177-845-094

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 45%

NON-FIBROUS MATERIALS:

Calcareous matrix, Glass beads

ASBESTOS TYPE:

*None Detected

PERCENT

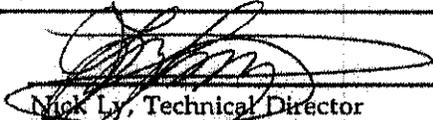
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076681 Client Sample #: 2177-845-095

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076683 Client Sample #: 2177-845-097

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20076684 Client Sample #: 2177-845-098

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material**OTHER FIBROUS MATERIALS:**

Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

ASBESTOS TYPE:

*None Detected

PERCENT

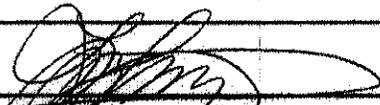
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076685 Client Sample #: 2177-845-099
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

PERCENT
ND

Lab ID #: 20076687 Client Sample #: 2177-845-101
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

PERCENT
ND

Lab ID #: 20076688 Client Sample #: 2177-845-102
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:
*None Detected

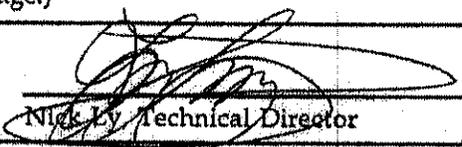
NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076689 Client Sample #: 2177-845-103

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076690 Client Sample #: 2177-845-104

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076691 Client Sample #: 2177-845-105

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

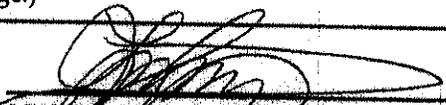
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1.9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Pilko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

Lab ID #: 20076692 Client Sample #: 2177-845-106

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076693 Client Sample #: 2177-845-107

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076694 Client Sample #: 2177-845-108

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

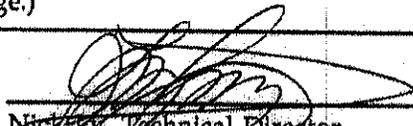
ASBESTOS TYPE:
*None Detected

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

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NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
 Client Project #: 2177-00F
 Number of samples: 67

Lab ID #: 20076695 Client Sample #: 2177-845-109

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076696 Client Sample #: 2177-845-110

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

Lab ID #: 20076697 Client Sample #: 2177-845-111

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
 Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 4%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Perlite

PERCENT

ND

(Sample results are continued on the next page.)

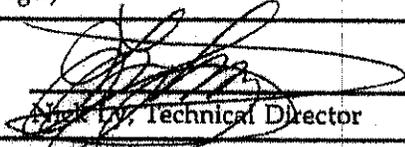
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/04/2000

Date: 08/04/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
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Bulk Asbestos Fiber Analysis

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield

NVL Batch Number: 00-09928.00
Client Project #: 2177-00F
Number of samples: 67

Lab ID #: 20076698 Client Sample #: 2177-845-112
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076699 Client Sample #: 2177-845-113
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20076700 Client Sample #: 2177-845-114
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield
Description: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
Cellulose 45%, Glass fibers 4%

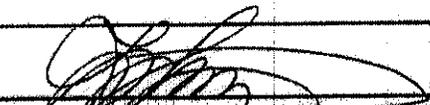
NON-FIBROUS MATERIALS:
Calcareous matrix, Perlite

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00
 Client Project #: 2177-00F
 Number of samples: 38

Lab ID #: 20081067 Client Sample #: 2177-845-115

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20081068 Client Sample #: 2177-845-116

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20081069 Client Sample #: 2177-845-117

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

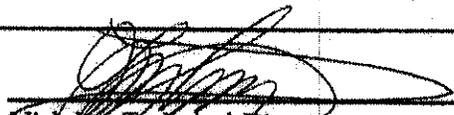
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20081070 Client Sample #: 2177-845-118

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20081071 Client Sample #: 2177-845-119

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

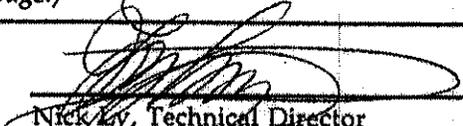
Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client	
Analyzed by: Steve Zhang	Date: 08/10/2000
Reviewed by: Nick Ly	Date: 08/10/2000


 Nick Ly, Technical Director

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 Attn: Mr. William Harris
 Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00
 Client Project #: 2177-00F
 Number of samples: 38

Lab ID #: 20081072 Client Sample #: 2177-845-120

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
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LAYER 1: *None Detected	ND
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LAYER 2: *None Detected	ND
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Lab ID #: 20081073 Client Sample #: 2177-845-121

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
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LAYER 1: *None Detected	ND
-------------------------	----

LAYER 2: *None Detected	ND
-------------------------	----

Lab ID #: 20081074 Client Sample #: 2177-845-122

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 15%

NON-FIBROUS MATERIALS:

LAYER 1: Perlite, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
-----------------------	----------------

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20081075 Client Sample #: 2177-845-123

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: Grey cementitious asbestos board

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:

Chrysotile

PERCENT

35%

Lab ID #: 20081076 Client Sample #: 2177-845-124

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Grey fibrous and porous material LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 15%**NON-FIBROUS MATERIALS:**LAYER 1: Perlite, Fine particles
LAYER 2: Asphalt/binder**ASBESTOS TYPE:**LAYER 1: *None Detected
LAYER 2: *None Detected**PERCENT**ND
ND

Lab ID #: 20081077 Client Sample #: 2177-845-125

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

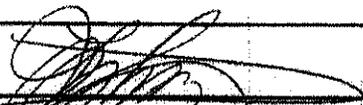
Glass fibers 65%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/10/2000
Date: 08/10/2000
Nick Ly, Technical Director

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 Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00
 Client Project #: 2177-00F
 Number of samples: 38

None Detected*ND**

Lab ID #: 20081078 Client Sample #: 2177-845-126
 Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Glass fibers 65%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:**PERCENT*****None Detected****ND**

Lab ID #: 20081079 Client Sample #: 2177-845-127

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Glass fibers 65%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:**PERCENT*****None Detected****ND**

Lab ID #: 20081080 Client Sample #: 2177-845-128

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

Glass fibers 65%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

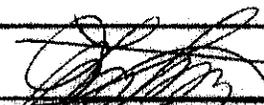
ASBESTOS TYPE:**PERCENT*****None Detected****ND**

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

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 Attn.: Mr. William Harris
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NVL Batch Number: 00-10092.00
 Client Project #: 2177-00F
 Number of samples: 38

Lab ID #: 20081081 Client Sample #: 2177-845-129

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material with surface mineral grains

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Glass fibers 35%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2:
 Asphalt/binder, Mineral/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 20081082 Client Sample #: 2177-845-130

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: Black asphaltic material

OTHER FIBROUS MATERIALS:

Cellulose 35%

NON-FIBROUS MATERIALS:

Asphalt/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20081083 Client Sample #: 2177-845-131

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
 Description: Black asphaltic material

OTHER FIBROUS MATERIALS:

Cellulose 35%

NON-FIBROUS MATERIALS:

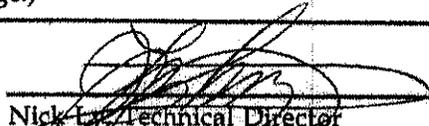
Asphalt/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/10/2000
 Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn.: Mr. William Harris
Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00
Client Project #: 2177-00F
Number of samples: 38

Lab ID #: 20081084 Client Sample #: 2177-845-132
Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: Black asphaltic material

OTHER FIBROUS MATERIALS:
Cellulose 35%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Asphalt/binder
PERCENT
ND

Lab ID #: 20081085 Client Sample #: 2177-845-133
Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: Black asphaltic material

OTHER FIBROUS MATERIALS:
Cellulose 35%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Asphalt/binder
PERCENT
ND

Lab ID #: 20081086 Client Sample #: 2177-845-134
Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: Black asphaltic material

OTHER FIBROUS MATERIALS:
Cellulose 35%

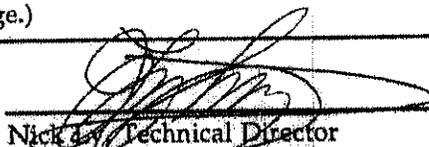
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Asphalt/binder
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000
Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

Lab ID #: 20081087

Client Sample #: 2177-845-135

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Beige/green paint LAYER 2: Brown fibrous material with silver metal foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 5%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Fine particles, Metal foil
LAYER 3: Fine particles, Glass beads**ASBESTOS TYPE:****PERCENT**

LAYER 1: Chrysotile	<1%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081088

Client Sample #: 2177-845-136

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Beige plastic material and mastic LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 4%
LAYER 2: Cellulose 3%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Plastic/binder, Mastic/binder
LAYER 3: Fine particles**ASBESTOS TYPE:****PERCENT**

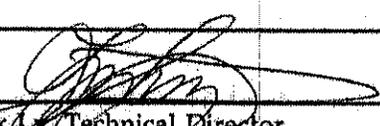
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

Lab ID #: 20081089

Client Sample #: 2177-845-137

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Brown fibrous material with silver metal foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 4%
LAYER 2: Cellulose 3%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Fine particles, Metal foil
LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081094

Client Sample #: 2177-845-142

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 15%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20081095

Client Sample #: 2177-845-143

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Glass fibers 4%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Rubber/binder, Fine particles

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20081096 Client Sample #: 2177-845-144

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: Black rubbery material with white woven fiber**OTHER FIBROUS MATERIALS:**

Glass fibers 15%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20081097 Client Sample #: 2177-845-145

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: LAYER 1: Silver metal foil LAYER 2: Yellow fluffy fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil
LAYER 2: Fine particles**ASBESTOS TYPE:**

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

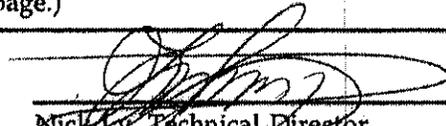
ND

ND

Lab ID #: 20081098 Client Sample #: 2177-845-146

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: LAYER 1: Silver metal foil LAYER 2: Yellow fluffy fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/10/2000
Date: 08/10/2000
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00
Client Project #: 2177-00F
Number of samples: 38

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey: Quad I and J, Schofield

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20081099 Client Sample #: 2177-845-147

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: LAYER 1: Grey calcareous matrix LAYER 2: Silver metal foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: *None Detected
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Metal foil
LAYER 3: Fine particles

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND
LAYER 3: *None Detected ND

Lab ID #: 20081100 Client Sample #: 2177-845-148

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield
Description: LAYER 1: Silver metal foil LAYER 2: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

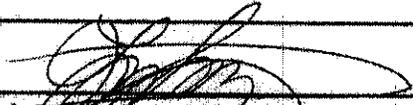
LAYER 1: Metal foil
LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000
Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

Lab ID #: 20081101

Client Sample #: 2177-845-149

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Silver metal foil LAYER 2: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20081102

Client Sample #: 2177-845-150

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Beige plastic material LAYER 2: White calcareous matrix LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 3%, Glass fibers 65%**NON-FIBROUS MATERIALS:**LAYER 1: Plastic/binder
LAYER 2: Calcareous matrix
LAYER 3: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: Chrysotile

2%

LAYER 3: *None Detected

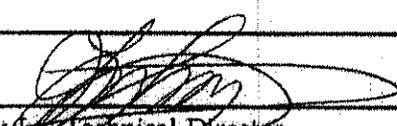
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

NVL Batch Number: 00-10092.00

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Client Project #: 2177-00F

Number of samples: 38

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey: Quad I and J, Schofield

Lab ID #: 20081103 Client Sample #: 2177-845-151

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Beige plastic material LAYER 2: White calcareous matrix LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 3%, Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Plastic/binder
LAYER 2: Calcareous matrix
LAYER 3: Fine particles

ASBESTOS TYPE:

LAYER 1: *None Detected
LAYER 2: Chrysotile
LAYER 3: *None Detected

PERCENT

ND
2%
ND

Lab ID #: 20081104 Client Sample #: 2177-845-152

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Brown fibrous material with white woven fiber and silver foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Fine particles, Metal foil
LAYER 3: Fine particles, Glass beads

ASBESTOS TYPE:

LAYER 1: Chrysotile
LAYER 2: *None Detected
LAYER 3: *None Detected

PERCENT

2%
ND
ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00

Client Project #: 2177-00F

Number of samples: 38

Lab ID #: 20081105 Client Sample #: 2177-845-153

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Brown fibrous material with white woven fiber and silver foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Fine particles, Metal foil
LAYER 3: Fine particles, Glass beads

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081106 Client Sample #: 2177-845-154

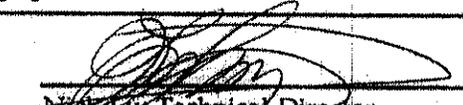
Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Brown fibrous material with white woven fiber and silver foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 45%
LAYER 3: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Fine particles, Metal foil
LAYER 3: Fine particles, Glass beads

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 08/10/2000
Date: 08/10/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn: Mr. William Harris
 Project: Asbestos & Lead Survey: Quad I and J, Schofield

NVL Batch Number: 00-10092.00
 Client Project #: 2177-00F
 Number of samples: 38

Lab ID #: 20081107 Client Sample #: 2177-845-155

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: Beige plastic material with silver foil LAYER 2: White calcareous matrix LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 5%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Plastic/binder
 LAYER 2: Calcareous matrix
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%
LAYER 3: *None Detected	ND

Lab ID #: 20081108 Client Sample #: 2177-845-156

Sample Location: Asbestos & Lead Survey: Quad I and J, Schofield

Description: LAYER 1: White calcareous matrix LAYER 2: Brown fibrous material with white woven fiber and silver foil LAYER 3: Yellow fluffy fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 45%
 LAYER 3: Glass fibers 75%

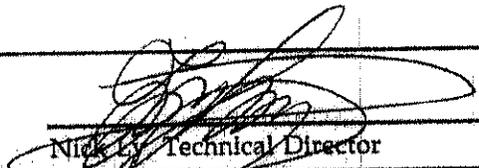
NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Fine particles, Metal foil
 LAYER 3: Fine particles, Glass beads

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 08/10/2000
 Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Lab ID #: 20081111 Client Sample #: 2177-845-157

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: White woven fibrous material with black soft material

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 30%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20081112 Client Sample #: 2177-845-158

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: White woven fibrous material with black soft material

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 30%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20081113 Client Sample #: 2177-845-159

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: White woven fibrous material with black soft material

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 30%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

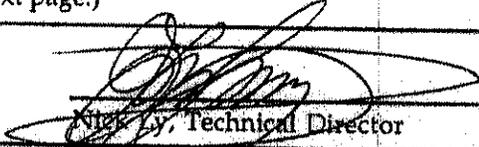
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081114 Client Sample #: 2177-845-160

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver paper with mastic and tan paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081115 Client Sample #: 2177-845-161

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver paper with mastic and tan paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081116 Client Sample #: 2177-845-162

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver paper with mastic and tan paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20081117 Client Sample #: 2177-845-163

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver paper with mastic and tan paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20081118 Client Sample #: 2177-845-164

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver paper with mastic and tan paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

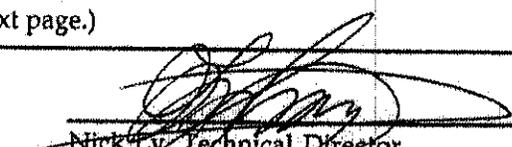
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Lab ID #: 20081119

Client Sample #: 2177-845-165

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: White/tan fibrous material with mastic and silver paper, LAYER 3: Yellow fibrous material, LAYER 4: Black lumpy foamy material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Glass fibers 10%, Cellulose 15%
LAYER 3: Glass fibers 80%
LAYER 4: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler
LAYER 4: Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20081120

Client Sample #: 2177-845-166

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: White/tan fibrous material with mastic and silver paper, LAYER 3: Yellow fibrous material, LAYER 4: Black lumpy foamy material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Glass fibers 10%, Cellulose 15%
LAYER 3: Glass fibers 80%
LAYER 4: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler
LAYER 4: Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

(Sample results are continued on the next page.)

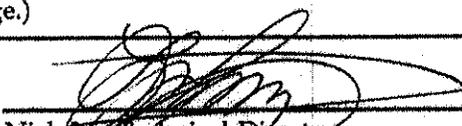
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1.9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081121

Client Sample #: 2177-845-167

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: Cream soft material with mastic, LAYER 3: White/tan fibrous material with mastic and silver paper, LAYER 4: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 1%
LAYER 3: Cellulose 15%, Glass fibers 10%
LAYER 4: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler, Mastic/binder
LAYER 4: Binder & filler**ASBESTOS TYPE:****PERCENT**

LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

Lab ID #: 20081122

Client Sample #: 2177-845-168

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: Cream soft material with mastic, LAYER 3: White/tan fibrous material with mastic and silver paper, LAYER 4: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 1%
LAYER 3: Cellulose 15%, Glass fibers 10%
LAYER 4: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler, Mastic/binder
LAYER 4: Binder & filler**ASBESTOS TYPE:****PERCENT**

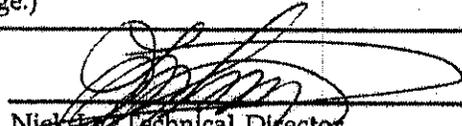
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND
LAYER 4: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44

Lab ID #: 20081123 Client Sample #: 2177-845-169

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: White/tan fibrous material with mastic and silver paper, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 20%, Glass fibers 13%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081124 Client Sample #: 2177-845-170

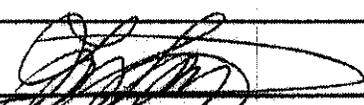
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: White/tan fibrous material with mastic and silver paper, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 20%, Glass fibers 13%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/10/2000
Date: 08/10/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.NVL Batch Number: 00-10093.00
Client Project #: 2177-00F
Number of samples: 44

Lab ID #: 20081125 Client Sample #: 2177-845-171

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material, LAYER 2: White/tan fibrous material with mastic and silver paper, LAYER 3:
Yellow fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 5%
LAYER 2: Cellulose 20%, Glass fibers 13%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081126 Client Sample #: 2177-845-172

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Black soft material with white woven fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 3%, Synthetic fiber 45%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 20081127 Client Sample #: 2177-845-173

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Black soft material with white woven fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:

Binder & filler

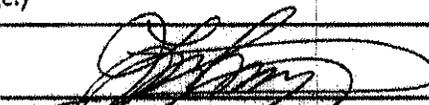
ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081128 Client Sample #: 2177-845-174

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Black soft material with white woven fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 3%, Glass fibers 35%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 20081129 Client Sample #: 2177-845-175

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver/tan paper with white woven fibrous material and mastic, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%, Glass fibers 13%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 20081130 Client Sample #: 2177-845-176

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver/tan paper with white woven fibrous material and mastic, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%, Glass fibers 13%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

(Sample results are continued on the next page.)

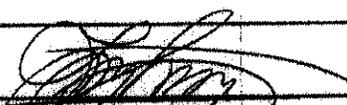
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081131 Client Sample #: 2177-845-177

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver/tan paper with white woven fibrous material and mastic, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%, Glass fibers 13%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081132 Client Sample #: 2177-845-178

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver/tan paper with white woven fibrous material and mastic, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%, Glass fibers 13%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20081133 Client Sample #: 2177-845-179

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Silver/tan paper with white woven fibrous material and mastic, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 35%, Glass fibers 13%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

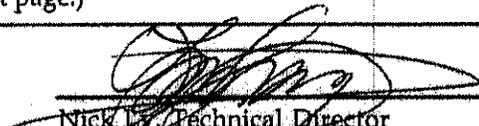
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 20081134 Client Sample #: 2177-845-180

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: Black brittle material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 25%, Glass fibers 10%
LAYER 3: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081135 Client Sample #: 2177-845-181

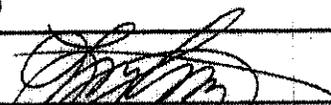
Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: Black brittle material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 25%, Glass fibers 10%
LAYER 3: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 08/10/2000
Date: 08/10/2000

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44

Lab ID #: 20081136 **Client Sample #: 2177-845-182**

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: Black brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 25%, Glass fibers 10%
 LAYER 3: Cellulose 1%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081137 **Client Sample #: 2177-845-183**

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 25%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

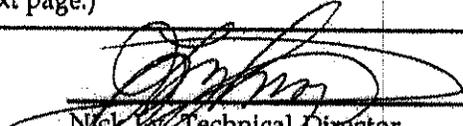
LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 08/10/2000
 Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0.3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081138 Client Sample #: 2177-845-184

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 25%, Glass fibers 10%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081139 Client Sample #: 2177-845-185

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Off-white soft material with paint, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

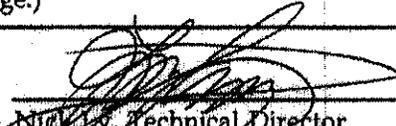
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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NVLAP
#102063

Bulk Asbestos Fiber Analysis

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44

Lab ID #: 20081140 Client Sample #: 2177-845-186

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White coating with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: White powdery material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 10%
LAYER 3: Cellulose 3%, Synthetic fiber 7%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20081141 Client Sample #: 2177-845-187

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White coating with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: White powdery material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 10%
LAYER 3: Cellulose 3%, Synthetic fiber 7%

NON-FIBROUS MATERIALS:

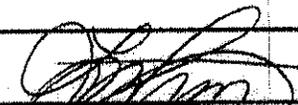
LAYER 1: Binder & filler, Paint
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/10/2000
Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Lab ID #: 20081142

Client Sample #: 2177-845-188

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White coating with paint, LAYER 2: Silver/tan paper with white woven fibrous material and mastic, LAYER 3: White powdery material, LAYER 4: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 25%, Glass fibers 10%

LAYER 3: Cellulose 3%, Synthetic fiber 7%

LAYER 4: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Mastic/binder

LAYER 3: Binder & filler

LAYER 4: Binder & filler

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

LAYER 3: *None Detected ND

LAYER 4: *None Detected ND

Lab ID #: 20081143

Client Sample #: 2177-845-189

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material and paint, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%, Glass fibers 10%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

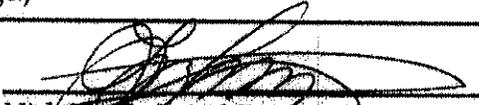
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081144

Client Sample #: 2177-845-190

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material and paint, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%, Glass fibers 10%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20081145

Client Sample #: 2177-845-191

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material and paint, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%, Glass fibers 10%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 20081146

Client Sample #: 2177-845-192

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 80%

NON-FIBROUS MATERIALS:

Binder & filler

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

(Sample results are continued on the next page.)

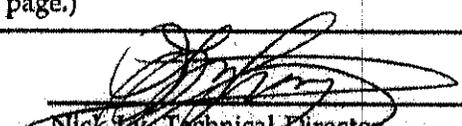
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00

Client Project #: 2177-OOF

Number of samples: 44

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081147

Client Sample #: 2177-845-193

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20081148

Client Sample #: 2177-845-194

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 20081149

Client Sample #: 2177-845-195

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

(Sample results are continued on the next page.)

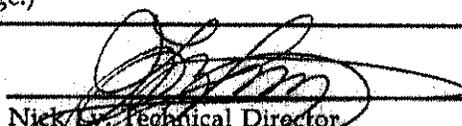
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44

Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20081150 Client Sample #: 2177-845-196

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Tan fibrous material

OTHER FIBROUS MATERIALS:
Cellulose 80%

NON-FIBROUS MATERIALS:
Binder & filler

ASBESTOS TYPE:
*None Detected

PERCENT
ND

Lab ID #: 20081151 Client Sample #: 2177-845-197

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: White fibrous material

OTHER FIBROUS MATERIALS:
Cellulose 10%, Synthetic fiber 55%

NON-FIBROUS MATERIALS:
Binder & filler

ASBESTOS TYPE:
Chrysotile

PERCENT
35%

Lab ID #: 20081152 Client Sample #: 2177-845-198

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Tan fibrous material with paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

NON-FIBROUS MATERIALS:
Binder & filler, Paint

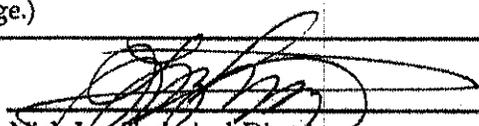
ASBESTOS TYPE:
*None Detected

PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/10/2000
Date: 08/10/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10093.00
Client Project #: 2177-OOF
Number of samples: 44

Lab ID #: 20081153 Client Sample #: 2177-845-199

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Tan fibrous material with paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 20081154 Client Sample #: 2177-845-200

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Tan fibrous material with paint

OTHER FIBROUS MATERIALS:
Cellulose 70%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

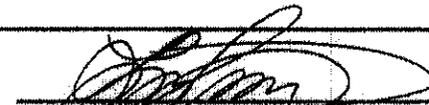
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/10/2000

Date: 08/10/2000



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10465.00

Client Project #: 2177-00F

Number of samples: 17

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20083665 Client Sample #: 2177-845-201

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Tan paper with white woven fibrous material and silver paper and mastic, LAYER 2: White powdery material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%, Glass fibers 20%
LAYER 2: Cellulose 15%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20083666 Client Sample #: 2177-845-202

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Tan paper with white woven fibrous material and silver paper and mastic, LAYER 2: White powdery material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 45%, Glass fibers 20%
LAYER 2: Cellulose 15%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler, Mastic/binder
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 20083667 Client Sample #: 2177-845-203

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 7%
LAYER 2: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler**ASBESTOS TYPE: PERCENT**

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/17/2000

Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10465.00
 Client Project #: 2177-00F
 Number of samples: 17

LAYER 1: Chrysotile 2%
 LAYER 2: *None Detected ND

Lab ID #: 20083668 Client Sample #: 2177-845-204

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material, LAYER 2: Silver paper with mastic and tan/white fibrous material, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 7%, Glass fibers 15%
 LAYER 2: Glass fibers 15%, Cellulose 45%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20083669 Client Sample #: 2177-845-205

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material, LAYER 2: Silver paper with mastic and tan/white fibrous material, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 7%, Glass fibers 15%
 LAYER 2: Glass fibers 15%, Cellulose 45%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 08/17/2000

Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-10465.00

Client Project #: 2177-00F

Number of samples: 17

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield.

Lab ID #: 20083670

Client Sample #: 2177-845-206

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material with white woven fibrous material, LAYER 2: Silver paper with mastic and tan/white fibrous material, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 7%, Glass fibers 15%
LAYER 2: Glass fibers 15%, Cellulose 45%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20083671

Client Sample #: 2177-845-207

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White coating, LAYER 2: Silver paper with mastic and tan/white fibrous material, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%
LAYER 2: Cellulose 45%, Glass fibers 15%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Date: 08/17/2000

Reviewed by: Nick Ly

Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10465.00

Client Project #: 2177-00F

Number of samples: 17

Lab ID #: 20083672 Client Sample #: 2177-845-208

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White coating, LAYER 2: Silver paper with mastic and tan/white fibrous material, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 45%, Glass fibers 15%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 20083673 Client Sample #: 2177-845-209

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: White soft material, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 7%
 LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	3%
LAYER 2: *None Detected	ND

Lab ID #: 20083674 Client Sample #: 2177-845-210

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.

Description: LAYER 1: Tan fibrous material, LAYER 2: White chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Date: 08/17/2000

Reviewed by: Nick Ly

Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10465.00
 Client Project #: 2177-00F
 Number of samples: 17

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083675 Client Sample #: 2177-845-211

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
 Description: LAYER 1: Tan fibrous material, LAYER 2: White chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083676 Client Sample #: 2177-845-212

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
 Description: LAYER 1: Tan fibrous material, LAYER 2: White chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 08/17/2000
 Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10465.00
 Client Project #: 2177-00F
 Number of samples: 17

Lab ID #: 20083677 Client Sample #: 2177-845-213

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
 Description: LAYER 1: Tan fibrous material, LAYER 2: White chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083678 Client Sample #: 2177-845-214

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
 Description: LAYER 1: Tan fibrous material, LAYER 2: White chalky material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 7%, Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 20083679 Client Sample #: 2177-845-215

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
 Description: Gray soft material with paint

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 08/17/2000
 Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

Tel: 206.547.0100
Fax: 206.634.1936

4708 Aurora Ave. N., Seattle, WA 98103

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Asbestos & Lead Survey; Quad I and J, Schofield.

NVL Batch Number: 00-10465.00
Client Project #: 2177-00F
Number of samples: 17

Lab ID #: 20083680 Client Sample #: 2177-845-216

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Gray soft material with paint

OTHER FIBROUS MATERIALS:
Cellulose 3%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Lab ID #: 20083681 Client Sample #: 2177-845-217

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield.
Description: Gray soft material with paint

OTHER FIBROUS MATERIALS:
Cellulose 3%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Binder & filler, Paint
PERCENT
ND

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 08/17/2000
Date: 08/17/2000

Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 00-09928.00

Client Project #: 2177-00F

Number of samples: 67

Attn.: Mr. William Harris

Project: Asbestos & Lead Survey; Quad I and J, Schofield

Sample Location: Asbestos & Lead Survey; Quad I and J, Schofield

Client Sample #: 2177-845-072

Lab ID #: 20076658

Sample Description: LAYER 1: Grey paint LAYER 2: Grey granular/sandy material

NON-FIBROUS MATERIALS:

LAYER 1: Paint
LAYER 2: Calcareous matrix, Sands

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 3%

ASBESTOS TYPE: PERCENT

LAYER 1: Chrysotile <1%
LAYER 2: *None Detected ND

COMMENTS: Percent determined by NESHAPS Point Count Method = 0.0% Asbestos in LAYER 1. Analyzed by NL on 09/15/00.

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 08/04/2000
Date: 08/04/2000


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

JL Laboratories, Inc.
 5 Aurora Ave. N, Seattle, WA 98103
 206.634.1879, Emerg. Pager: 344.1878
 1.800.509.4005

**CHAIN of CUSTODY
 SAMPLE LOG**

NL

Client Edward K. Noda & Assoc.
 Address 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number 00-09928
 Client Job Number 2177-00F
 Total Samples 1

Project Manager Will Harris

Project Location Quad I & J, Schofield

Phone Number 808-591-8553

Fax Number 808-593-8551

Pager Number _____

**Type of Analysis (check one)*

ASBESTOS	LEAD (Pb)
<input type="checkbox"/> PCM(air)	<input type="checkbox"/> Paint Chips
<input type="checkbox"/> PLM(bulk)	<input type="checkbox"/> Soil
<input checked="" type="checkbox"/> OTHER, <u>Point Count</u>	<input type="checkbox"/> Dust/wipe
	<input type="checkbox"/> Air
	<input type="checkbox"/> TCLP

Turn Around Time (check one)

1-Hr 24-Hrs 3 to 5 days
 4-Hrs 48-Hrs

Condition of Package:

Good
 Damaged (no spillage)
 Severe damage (spillage)

Seq. #	Lab ID	Clients Sample #	A/R	Seq. #	Lab ID	Clients Sample #	A/R
1	20076658	2177-845-072		11			
2				12			
3				13			
4				14			
5				15			
6				16			
7				17			
8				18			
9				19			
10				20			

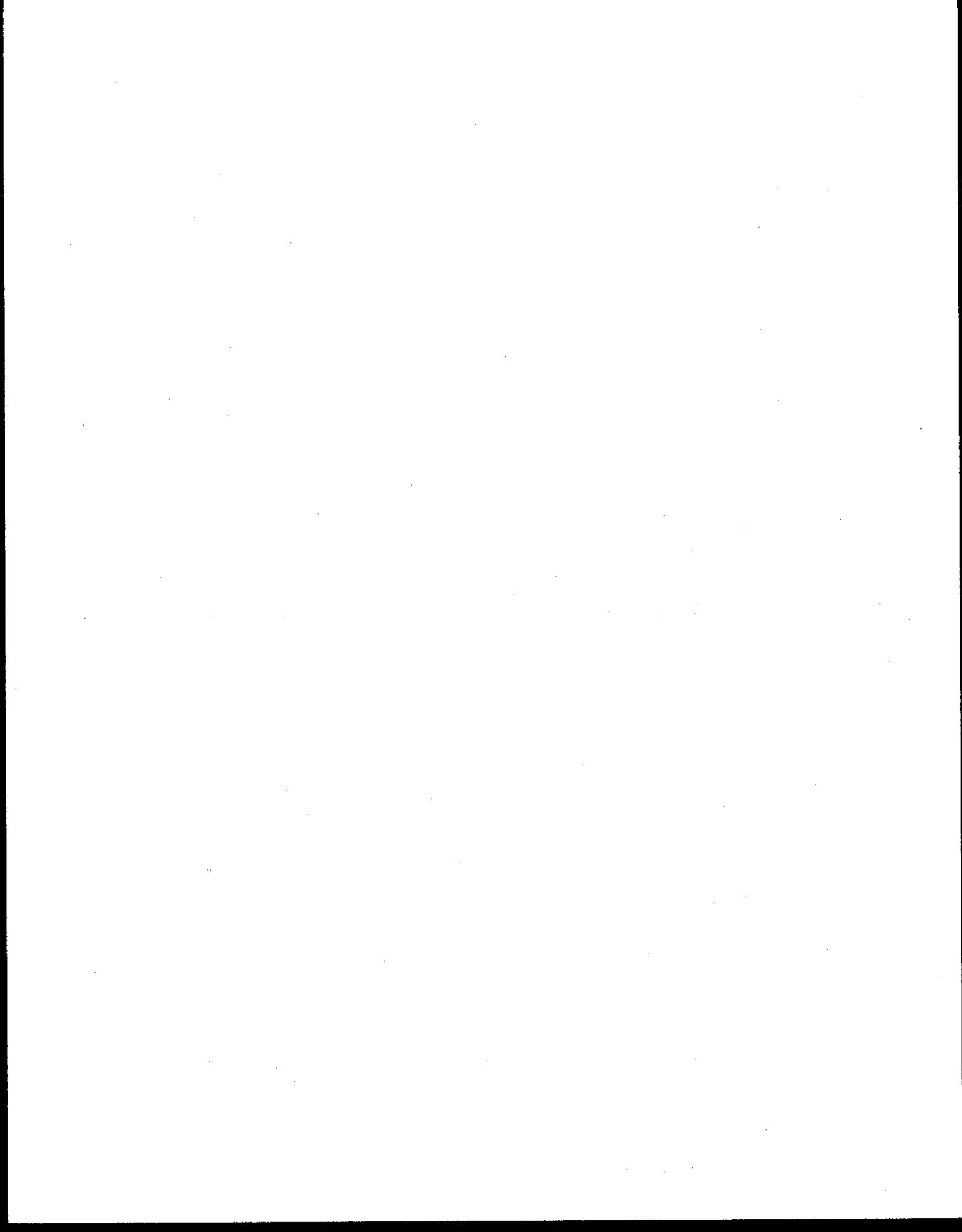
	DATE	TIME
Sampled By:		
Relinquished By:		
DELIVERED BY:		
Received By: <u>NL</u>	9/14/00	4:30 pm
Analyzed By:	9/15/00	9:00 am
Results called in by:		
Results Faxed by:		

SPECIAL INSTRUCTIONS:

Requested Point Count by Doug 9/14/00 4:15 pm

August 9, 2000

*Unless requested in writing, all samples will be disposed two (2) weeks after analysis.



FINAL INSPECTION REPORT

Volume III

**Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility
Schofield Barracks, Island of Oahu, Hawaii**

Contract No: DACA83-00-D-0012

Task Order No: 0012

PREPARED FOR:

U.S. Army Corps of Engineers
Pacific Ocean Division
Fort Shafter, Oahu, Hawaii

Through:

Wil Chee Planning, Inc.
HMSA Center
1400 Rycroft Street, Suite 928
Honolulu, Hawaii 96814

Prepared by:

EDWARD K. NODA & ASSOCIATES, INC.
615 Piikoi Street, Suite 300
Honolulu, Hawaii 96814

CN 2197-00F

June 2001

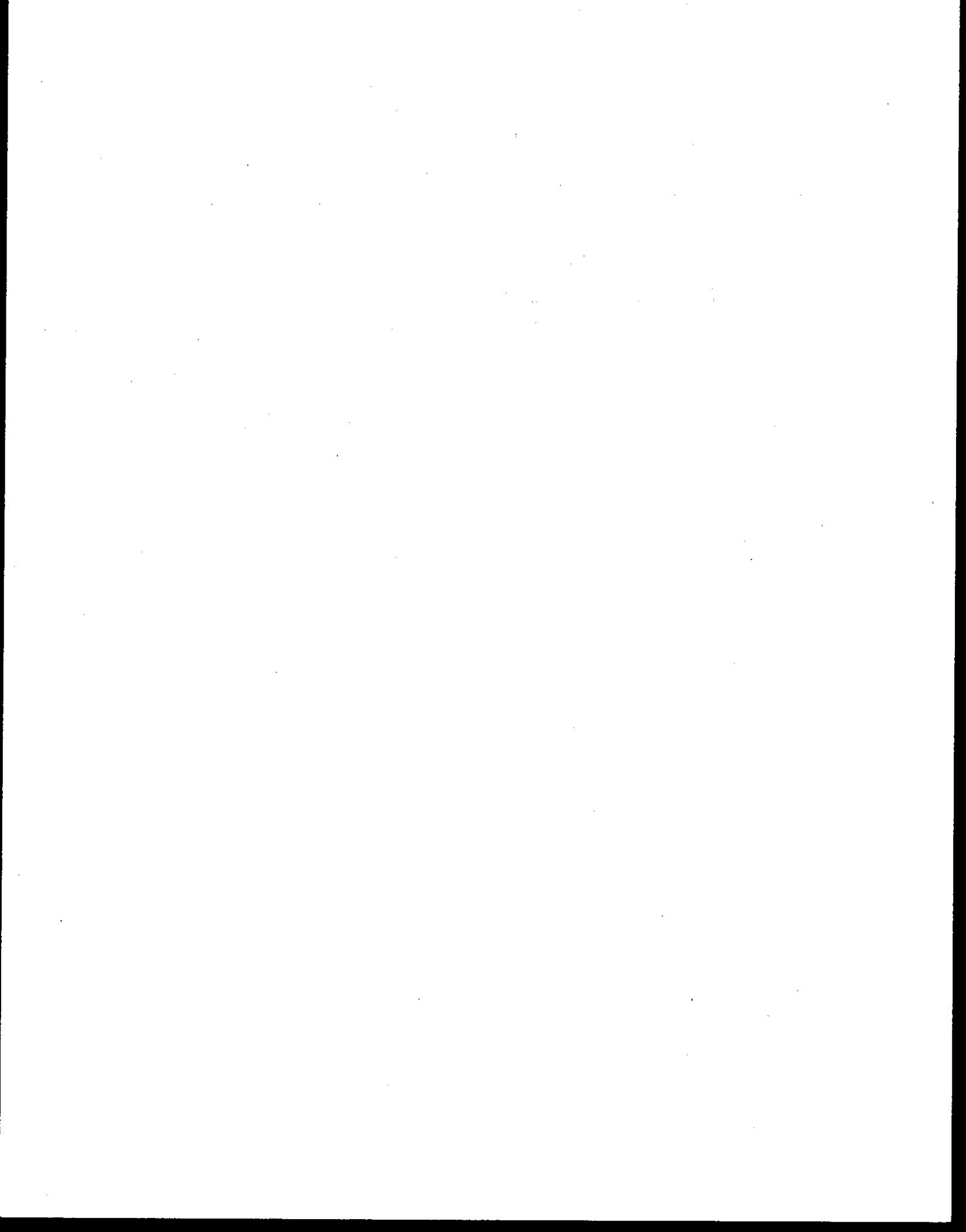
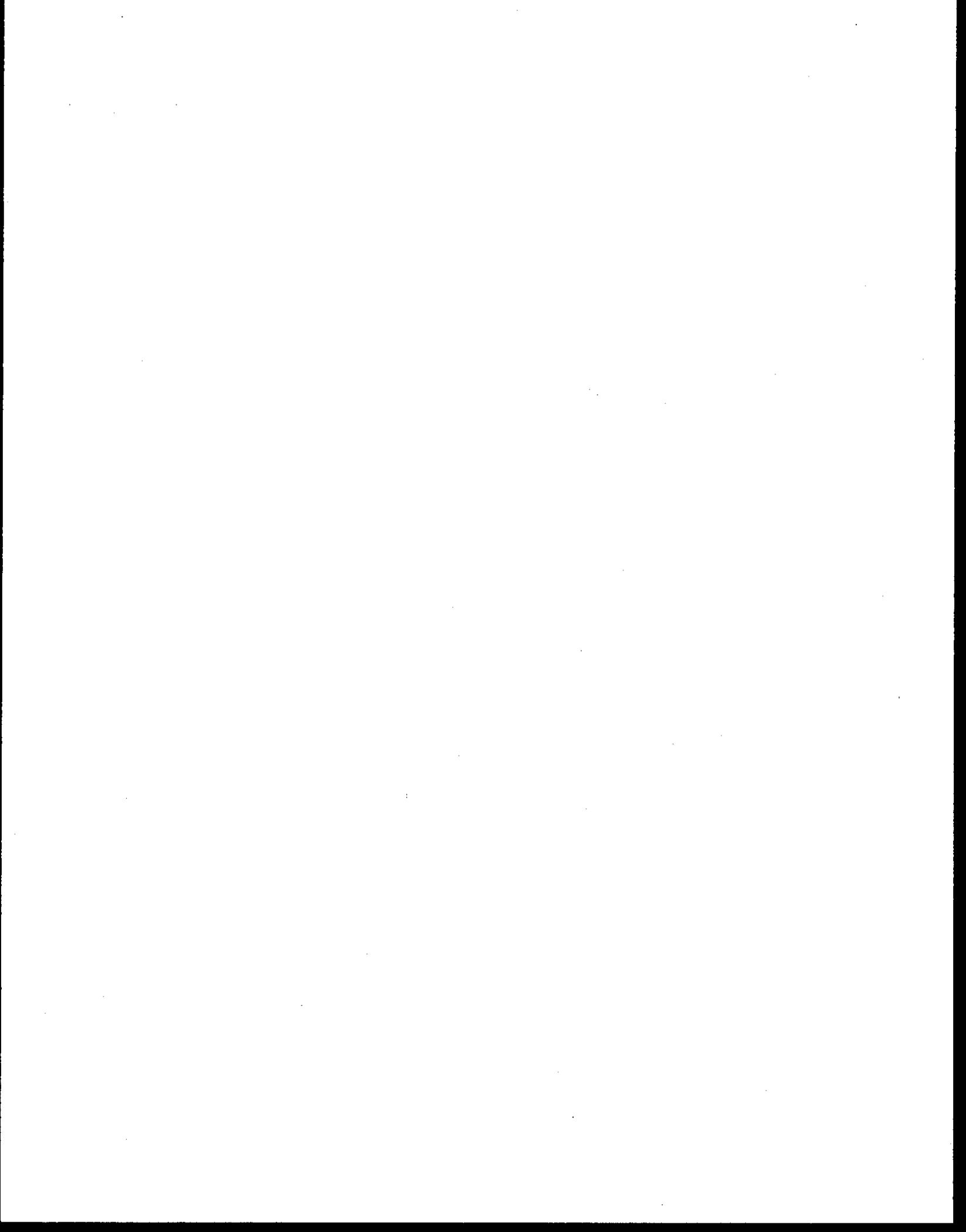


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APPENDICES

APPENDIX A	BUILDING 847
APPENDIX B	BUILDING 855 "DIVARTY" DINING FACILITY
APPENDIX C	INSPECTOR CERTIFICATES
APPENDIX D	LABORATORY CERTIFICATES



I. EXECUTIVE SUMMARY

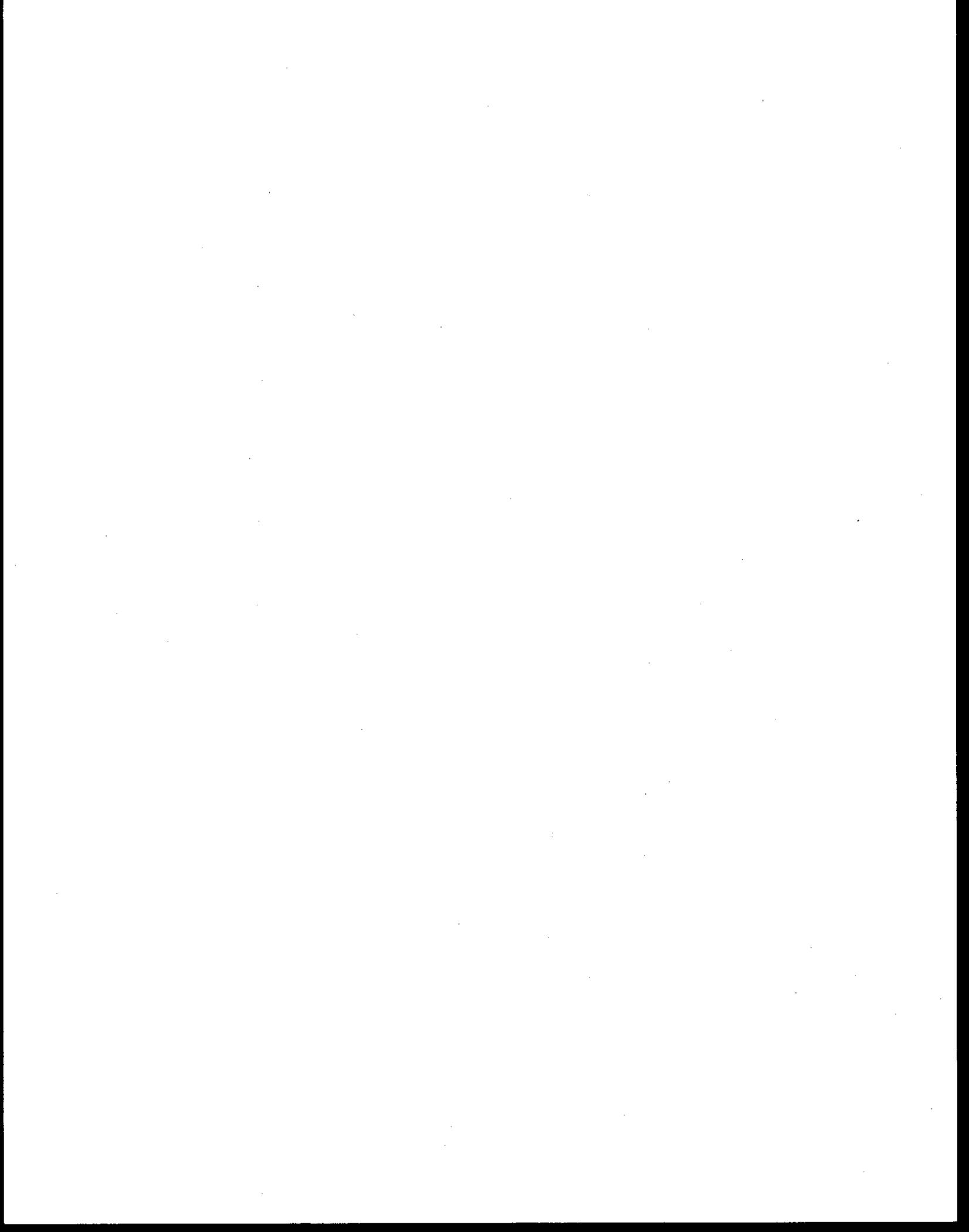
Edward K. Noda & Associates, Inc. (EKNA) was retained by Wil Chee Planning, Inc., HMSA Center, 1400 Rycroft Street, Suite 928, Honolulu, Hawaii 96814, to conduct an investigative asbestos survey of Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility at Schofield Barracks, Island of Oahu, Hawaii, for visible and accessible asbestos-containing building materials (ACBM) which may be required to be abated prior to any renovation activities.

EKNA's certified asbestos inspectors Christine Arouh, Steven Chun, William Harris, Prudy Stoudt-McRea, Kennyson Thomas and Doug Tisdell conducted an investigative survey from February 23rd through February 28th, 2001 of Quad J - Building 847 and from April 18th through April 30th, 2001 of Quad J - Building 855 "DIVARTY" Dining Facility. EKNA collected three hundred and seventy nine (379) suspect asbestos-containing building material (ACBM) samples and identified one hundred twenty six (126) distinct material types from Buildings 847 and 855.

The investigative asbestos survey found the following ACBMs in the following buildings. Materials found to contain greater than one percent asbestos are indicated in **bold print** (an asterisk indicates a friable material).

Building 847

12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 1st Floor
12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 2nd Floor
12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 3rd Floor
12"x12" VFT - Blue and **Black Mastic**, 1st Floor
12"x12" VFT - White w/Tan Streaks and **Black Mastic**, 2nd Floor
12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 1st Floor
12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 2nd Floor
12"x12" VFT - Black w/White Streaks and **Black Mastic**, 1st Floor
9"x9" VFT Green and **Black Mastic**, 1st Floor
Carpet Adhesive and **Mastic**
VFT - Tan and Black Mastic
VFT - Tan w/Olive Streaks and **Black Mastic**
VFT - Tan Streaked and **Black Mastic**
VFT - Rust/Brown Streaked and Black Mastic
VFT - Tan w/Light Brown Streaks and Black Mastic
VFT - Cream w/Light Brown Streaks and Black Mastic
VFT - Tan w/Light Brown/Cream Streaks and Black Mastic
Cove Base Adhesive and **Black Asphaltic Material**
Cementitious Panels at Eaves
4"-6" Roof Vent Sealant/Flashing - Main Roof
Beige Paint w/Black Asphaltic Undercoat - Main Roof
12'x12" Vent Flashing - Main Roof
Pipe Mount Flashing - Main Roof



Roof Vent Patch Material Black - Above 1st Floor Restroom

- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 1st Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 1st Floor**
- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 2nd Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 2nd Floor**
- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 3rd Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 3rd Floor**

Building 855

9"x9" Vinyl Floor Tile (VFT) - Green w/White Streaks and Mastic

12"x12" VFT - Brown w/White Streaks and Mastic

12"x12" VFT - Green and Mastic

12"x12" VFT - Brown Marbled and Mastic

***Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows 4"**

Building 855, Upper Roof

Electrical Conduit Flashing/Sealant - Upper Roof

Ventilation Duct/Metal Flashing Coating - Silver - Upper Roof

Building 855, Lower Roof

Asphaltic Patching Material - Lower Roof

Electrical Conduit Flashing/Sealant - Lower Roof

Ventilation Duct/Metal Flashing Coating - Silver - Lower Roof

II. INTRODUCTION

The objective of this field survey and report was to assess the existence and extent of ACM in Building 847 and 855 "DIVARTY" Dining Facility Schofield Barracks, which are scheduled for renovation/demolition.

EKNA's scope of work included an investigative asbestos survey, collection and testing of suspect asbestos-containing material samples, and provide a written report summarizing the survey with test results for Quad F - Buildings 649, 650, 651 and 652, Quad I - Buildings 745 & 746 and Quad J Building 847 & 855 "DIVARTY" Dining Facility at Schofield Barracks.

EKNA's investigative ACM survey is segregated into the following three (3) volumes and addresses each identified building listed below:

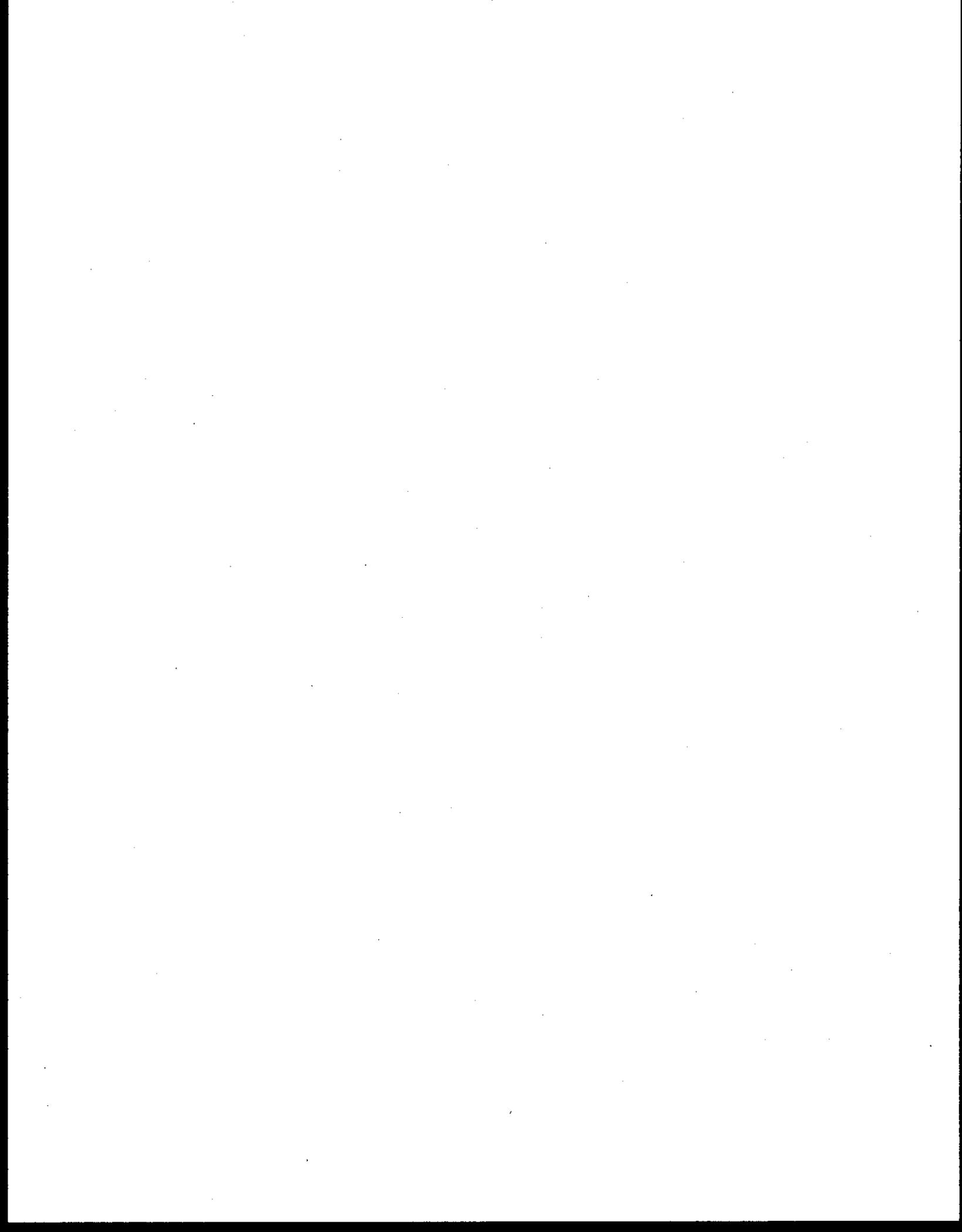
Volume I Quad F - Building 649, 650, 651 and 652

Volume II Quad I - Buildings 745 and 746

Volume III

Final Asbestos Survey, Analysis and Report for:

Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii



Volume III Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility

Building 847 is a 3-story concrete structure which provide office space on the first floor and living quarters on the second and third floors. The primary hot water heater is located on the first floor. Building 855 "DIVARTY" Dining Facility is a single story structure that serves as a Dining facility (Divarty).

II. SURVEY METHODOLOGY

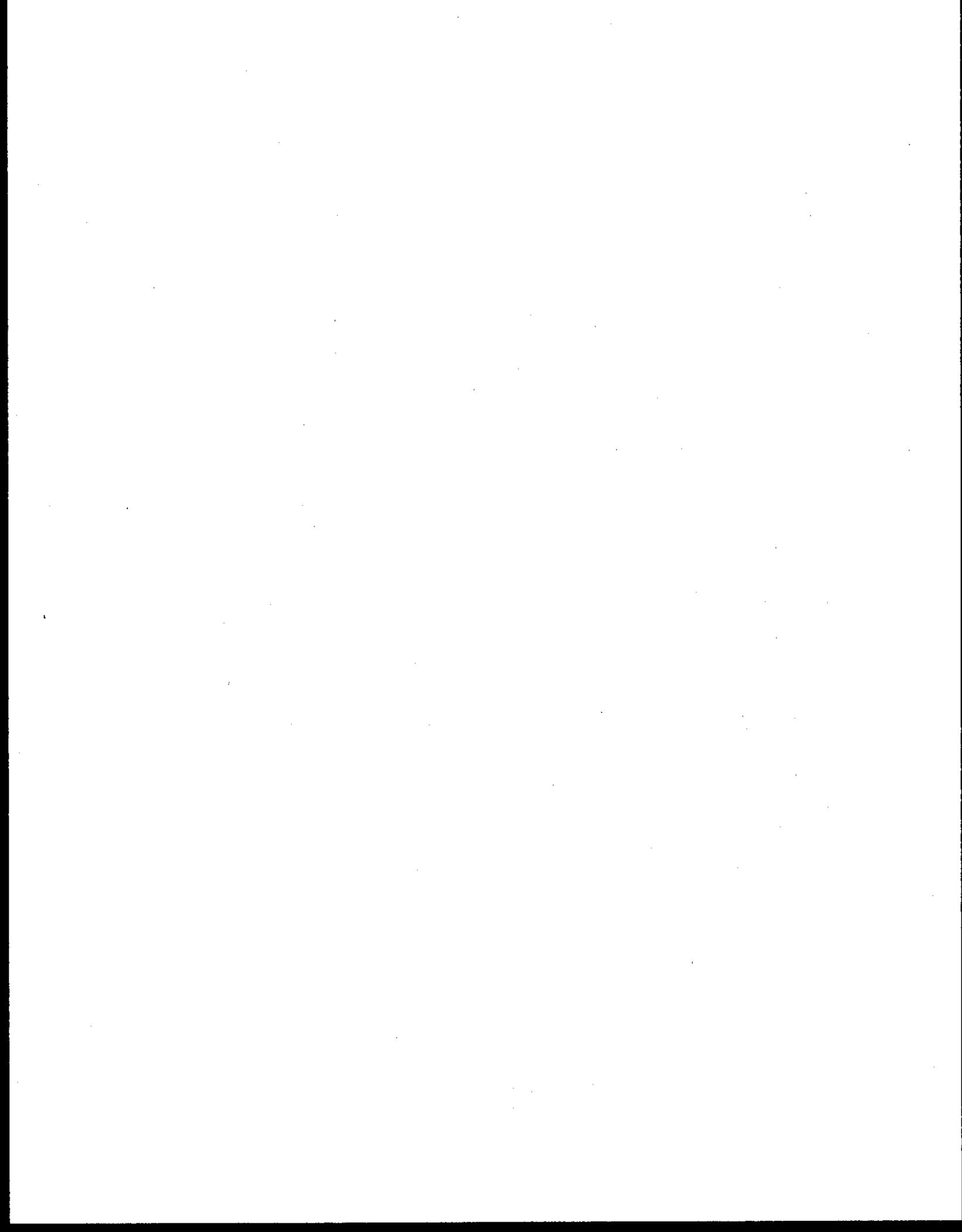
EKNA's certified asbestos inspectors Christine Arouh, Steven Chun, William Harris, Prudy Stoudt-McRea, Kennyson Thomas and Doug Tisdell (see Appendix C for Inspector Certificates) conducted an investigative survey of accessible building materials for the presence of suspect ACM. During the survey three hundred and ninety two (392) suspect ACM samples were collected from one hundred thirty two (132) distinct material types at Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility (see Table 1 for per building breakdown).

Table 1

Building Number	Samples Collected	Homogeneous Material Identified
847	252	82
855	140	50
Total(s)	392	132

AHERA is the federal law (40 CFR 763) instituted to regulate asbestos in schools. In addition to AHERA, the EPA has issued a document titled "Guidance for Controlling Asbestos-Containing Materials in Buildings" (Document number EPA 560/5-85-024) for buildings which are not governed by AHERA legislation. During an asbestos assessment, one of the most important characteristics of a material that AHERA & EPA addresses is "friability". AHERA describes "friable" as those materials that when dry may be crumbled, pulverized, or reduced to powder by hand pressure. The term includes previously non-friable material after it becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure. In addition, AHERA regulations require that for any homogenous sampled material (i.e., materials with similar location, function, thickness and color), if one sample of a given material tests positive for asbestos (greater than one percent asbestos), the entire homogenous material is considered positive for asbestos.

AHERA regulations require that for an Homogeneous Sampling Material (HSM), if one sample tests positive for asbestos, the entire HSM type is considered asbestos-containing. For this reason, EKNA directs the laboratory to stop analysis at the first positive result (asbestos content in excess of one percent) for each homogeneous material type, if more than one sample is presented for an HSM.



The appearance of each material and date of installation were considered to ensure that materials known to have been installed at different times would be sampled as a separate HSM.

After completing an inventory of building materials, EKNA collected samples of each suspect material. Drawings are provided in each applicable appendices that depict the locations of all samples collected.

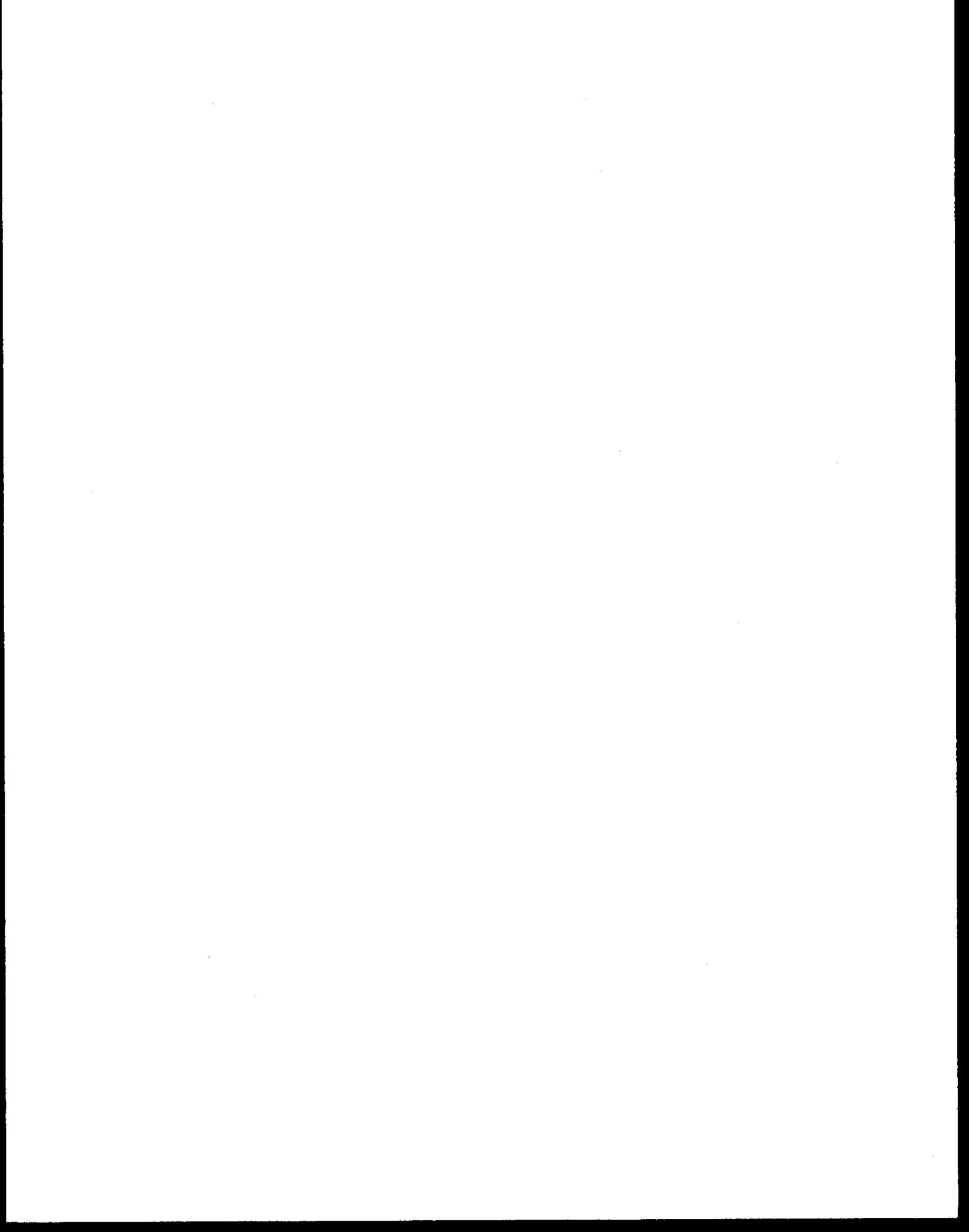
The number of samples collected was determined by the extent of HSM within the building space, in accordance with the sampling protocol contained in 40 CFR 763. HSM is analogous to the homogeneous area as defined by 40 CFR 763. In general, an HSM is identified as that area or amount of suspect ACBM which is uniform in color and texture. For example, the pipe runs of a domestic hot water system would be a single HSM provided that the material does not differ in appearance, color, or texture throughout the system. When a system or area appears to consist of dissimilar materials, then the system or area is separated into as many HSMs as necessary to define all suspect materials present.

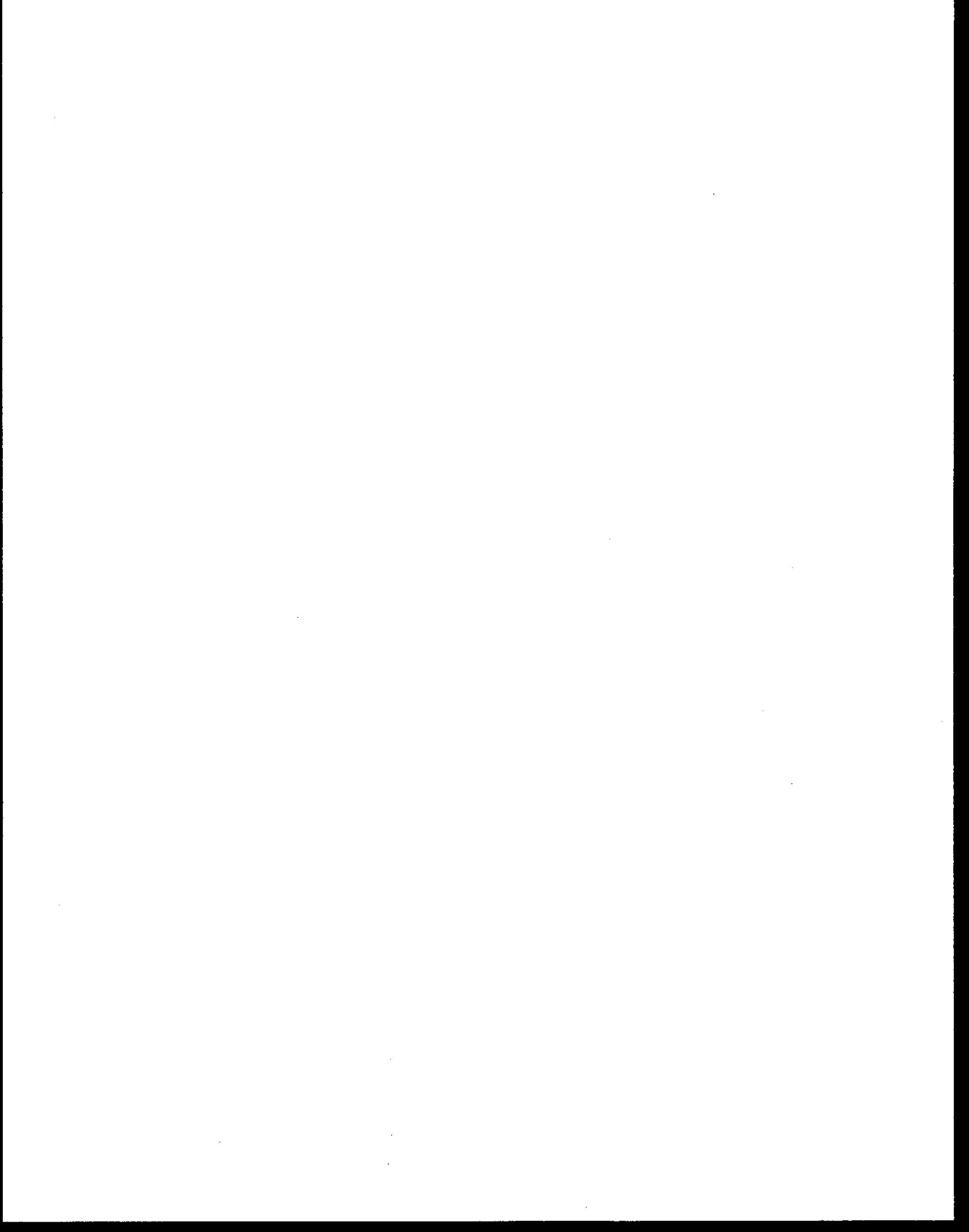
If two HSM are similar in appearance or texture and cannot be described uniquely, a type number is assigned to differentiate them. For example, if distinct but HSM are similar in appearance, the first is identified as Type I and the second as Type II (e.g., Brown 12"x12" Vinyl Floor Tile - Type I, Brown 12"x12" Vinyl Floor Tile - Type II, etc.). This procedure minimizes the potential of incorrect conclusions based exclusively upon the appearance of the material or the construction period during which it was installed.

Each sample was placed in an individual sample bag, sealed and labeled with a unique sample identification number. Sample locations are depicted in scale drawings of the buildings in Appendix A & B. All samples were submitted to NVL Laboratories, Inc. of Seattle, Washington, for analysis to determine asbestos content. NVL Laboratories, Inc. participates in the National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP) mandated by EPA under the AHERA regulations. A copy of the laboratory certification is provided in Appendix D.

The samples were analyzed according to EPA methods described in EPA 660/R-93/116 utilizing Polarized Light Microscopy (PLM). Using the PLM method, the analyst is able to determine the type and concentration of asbestos in each sample. The concentration is provided as a percentage of the total area (total area is determined by the field of view while observed through the microscope) of the sample material. The limit of detection for this particular method is less than one percent (<1%). As with most analyzing techniques there is a variance associated with PLM analysis and for this reason the results are presented as a reliable range. Where results are reported as "<1%" or "Trace", this indicates that at least one asbestos fiber was detected. Where results are reported as "No Asbestos Detected" or "ND", no asbestos fibers were found.

Each layer in a sample is viewed and analyzed by NVL as a distinct material, and analysis results reported with the asbestos percentages determined by the analyst in each layer of the suspect material. The individual layer information is important in that for many cases of multi-





non-friable ACM not included in Category I) that have a high probability of becoming, or have become, crumbled, pulverized, or reduced to powder by hand pressure or the forces expected to act on the material in the course of demolition or renovation operations.

The EPA interpretation of the NESHAP regulations state that, in general, Category I and Category II non-friable materials will not release significant amounts of asbestos fibers during normal renovation activities. However, non-friable ACM which will be subject to sanding, grinding, abrading, drilling, cutting or chipping must be treated as if it were friable.

Under normal circumstances non-friable Category I and Category II ACMs in good condition (such as the mastics and roofing materials located in this survey), need not be removed prior to renovation or demolition activities. However, the local landfill may exercise discretion as to whether to permit disposal of non-friable Category I and II ACMs as a general construction waste. On Oahu, construction demolition waste landfills generally require the handling and disposal of non-friable Category I and II ACMs as though they were friable Category I ACMs.

If the amount of RACM present in an area to be renovated exceeds 260 linear feet, 160 square feet, or 35 cubic feet, the following general actions are required:

A Notification of Demolition and Renovation must be sent to the EPA and to the Hawaii State Department of Health, Clean Air Branch, at least ten working days prior to beginning work.

A licensed asbestos abatement contractor is required to perform the work. Workers must have received from eight to thirty two hours of training (dependent on type of work conducted), be medically examined and certified fit to wear a respirator, have been individually fitted to personally issued respirators, and operate under the supervision of a competent person as defined in 29 CFR 1910.1101.

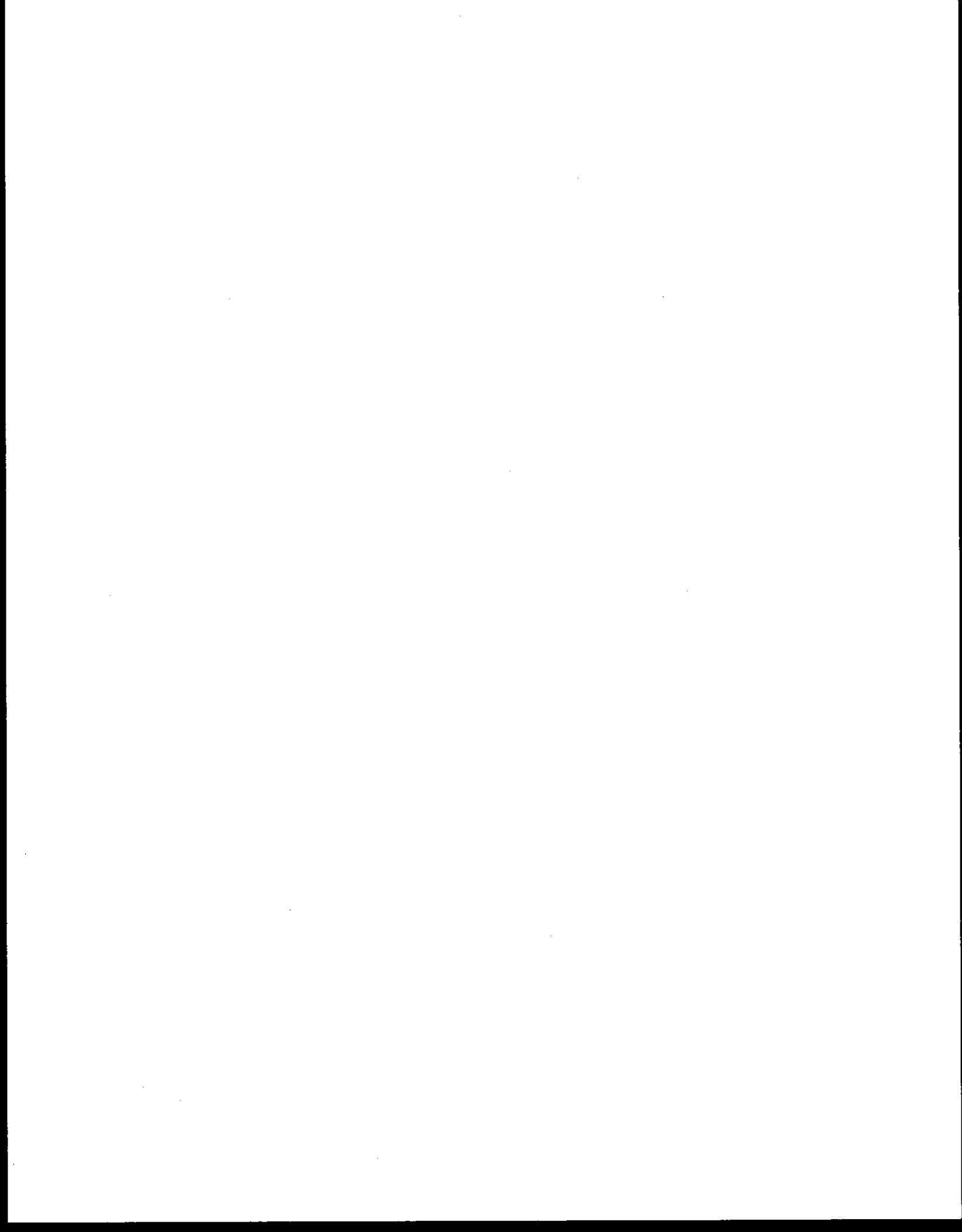
Various engineering controls for the prevention of visible and/or airborne emissions must be implemented.

Asbestos-containing waste must be thoroughly wetted and properly sealed, labeled, transported and disposed of in a permitted landfill.

VI. RECOMMENDATIONS

Renovation/demolition of Building 847 and 855 will result in disturbance of asbestos-containing materials and abatement is generally required prior to demolition. Due to the quantity and extent of the ACM, a licensed abatement contractor will be required to perform this work.

We recommend that construction specifications detailing work practices, protective measures, and engineering controls to be employed in disturbance of each type of ACBM be prepared and



incorporated into the construction documents. Additionally, we recommend that air monitoring at the work area perimeter ("area" air monitoring) be employed to verify the cleanliness of the contractor's work practices and engineering controls, and to ensure that asbestos fibers in concentrations exceeding the Permissible Exposure Limit are not present at the site upon completion of the abatement contractor's work in each work area.

Abatement of friable Category I materials should be carried out in full containment, which includes protection of non-ACM surfaces by two layers of plastic sheeting, sealing of passages to areas outside the work area, negative air pressure within the work area, HEPA-filtered exhaust, and provision of a three-room decontamination facility.

Disturbance of non-friable Category I and Category II ACBM (ACBM which is not thermal system insulation or surfacing material, including vinyl floor tile mastics, sink insulation, and composition roofing), is subject to less severe restrictions during conduct of work. These materials are less likely to generate airborne asbestos fibers during abatement work.

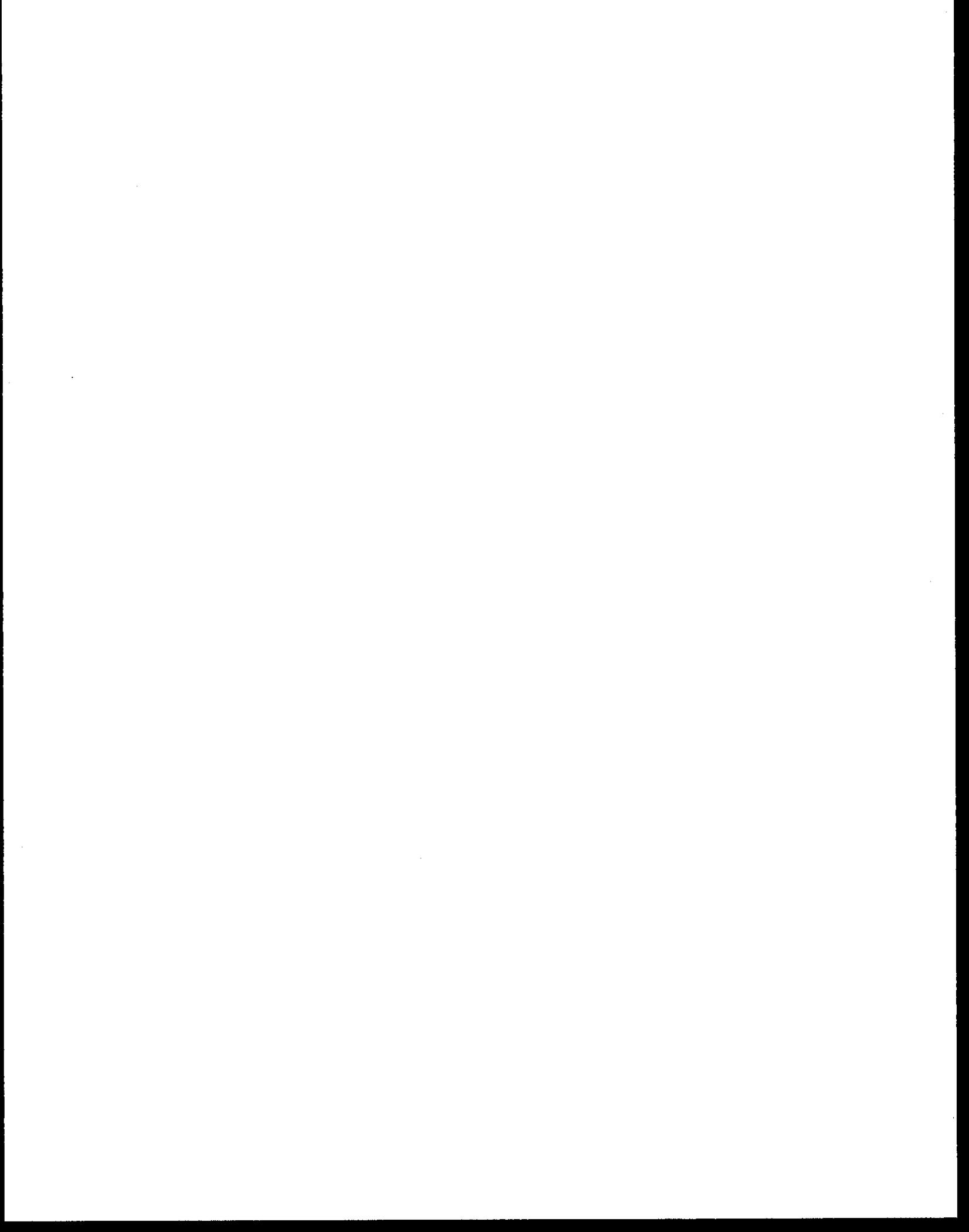
Work practices for disturbance of non-friable materials (flooring mastic, window caulking and sink insulation) should include HEPA filtered air exhaust from the work area, use of wet methods, intact removal to the extent possible and OSHA-required monitoring of asbestos fiber concentrations in the breathing zone air of all workers. Polyethylene sheeting should be placed on walls adjacent to areas in which non-friable flooring materials will be disturbed, and workers should enter and exit through a decontamination facility.

Exterior non-friable Category I and Category II materials may be abated using wet methods, intact removal to the extent possible, and worker entry and exit through a decontamination facility. Abatement exterior workers shall wear respiratory protection and personal air monitoring of abatement workers breathing zone would be required.

VII. LIMITATIONS

This survey addressed identification of accessible asbestos and non-asbestos materials in areas within the agreed upon scope of work for this project of Quad F - Buildings 649, 650, 651 and 652, Quad I - Buildings 745 and 746 and Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Island of Oahu, Hawaii and was limited to visible and accessible suspect asbestos-containing building materials (ACBMs) which may be required to be abated prior to any renovation/demolition activities. A possibility does exist that ACBM may be present in areas which were not surveyed, or inaccessible areas.

Some examples of inaccessible areas may be inaccessible tunnels containing pipe/valve insulation and asbestos materials within solid wall cavities. If suspect materials beyond those identified in this report are encountered during renovation/demolition activities, samples should be collected and submitted for analysis immediately. Materials at other locations which are the same in manufacture, texture, color, thickness, etc. as those which have been identified as ACBMs should also be assumed to be ACBMs.

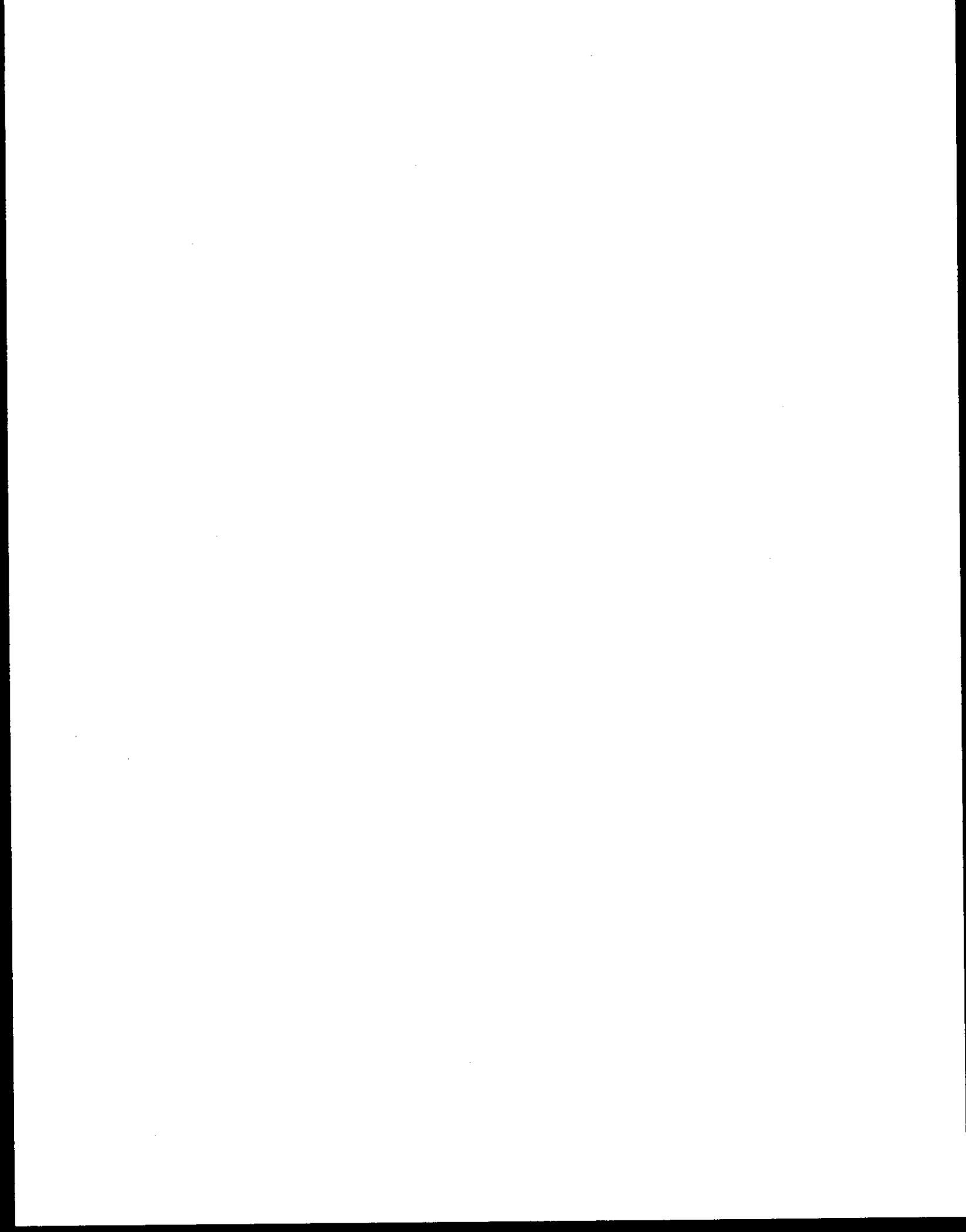


This Asbestos Containing Building Material Survey Report provides information on the visible and accessible suspect asbestos containing materials sampled of Quad I - Buildings 745 and 746 at Schofield Barracks, Island of Oahu, Hawaii. It should not be construed as a final statement of the presence and condition of all asbestos containing materials at the subject property.

The information set forth is based solely on the agreed upon scope of services. This information is based on personal observation and the results of the asbestos-containing material survey. Edward K. Noda and Associates, Incorporated expressly disclaims any and all liability representations, expressed, or implied, contained in, or for omissions from this report, or any other written or oral communication which might be interpreted as establishing the total extent of all liability present at the subject property.

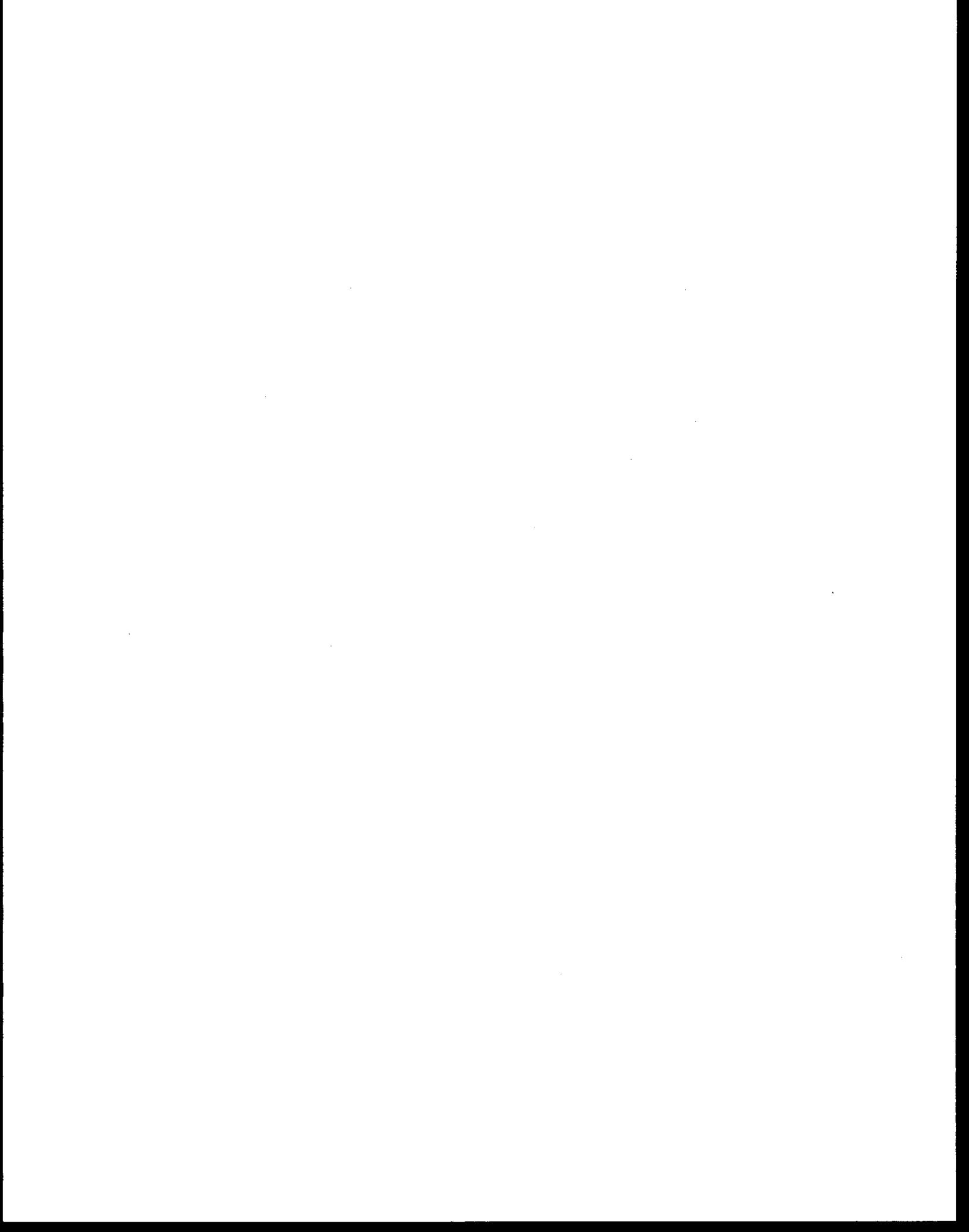
Our services have been performed with the usual thoroughness and competence of the consulting profession, in accordance with the standards of professional services at this time. No other warranty or representation, either expressed or implied, is included or intended.

EDWARD K. NODA & ASSOCIATES, INC.



APPENDIX A
BUILDING 847

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii



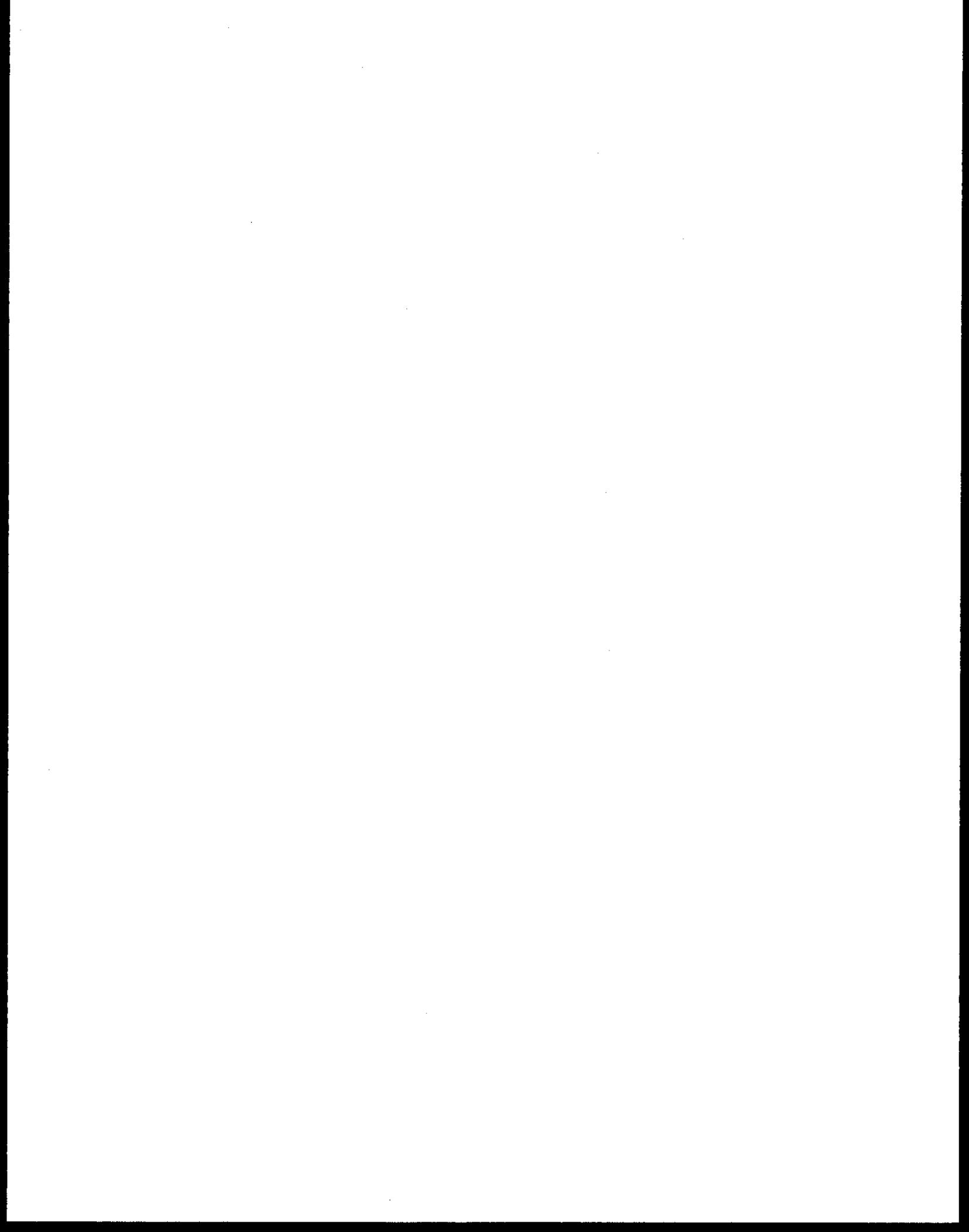
I Introduction

Building 847 is a 3-story concrete structure which provides office space on the first and second floors, the third floor consists of living quarters. A primary hot water heater and storage tank is located on the first floor of the building.

II Summary of Identified ACBM

Materials found to contain >1% asbestos are indicated in **bold print**, an asterisk preceding the material description indicates the material is considered friable or potentially friable.

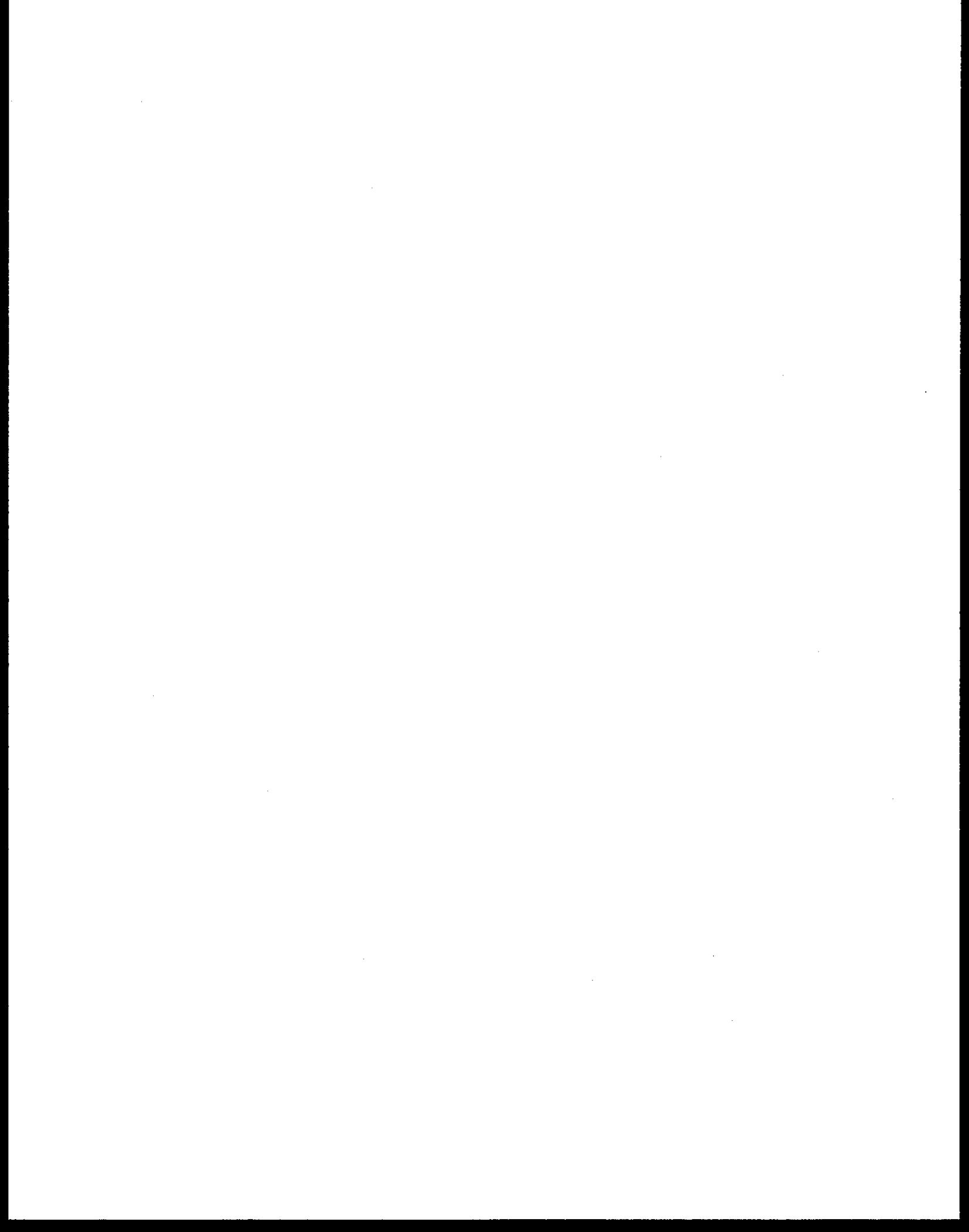
- 12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 1st Floor
- 12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 2nd Floor
- 12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 3rd Floor
- 12"x12" VFT - Blue and **Black Mastic**, 1st Floor
- 12"x12" VFT - White w/Tan Streaks and **Black Mastic**, 2nd Floor
- 12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 1st Floor
- 12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 2nd Floor
- 12"x12" VFT - Black w/White Streaks and **Black Mastic**, 1st Floor
- 9"x9" VFT Green and **Black Mastic**, 1st Floor
- Carpet Adhesive and **Mastic**
- VFT - Tan and Black Mastic**
- VFT - Tan w/Olive Streaks and **Black Mastic**
- VFT - Tan Streaked and **Black Mastic**
- VFT - Rust/Brown Streaked and Black Mastic**
- VFT - Tan w/Light Brown Streaks and Black Mastic**
- VFT - Cream w/Light Brown Streaks and Black Mastic**
- VFT - Tan w/Light Brown/Cream Streaks and Black Mastic**
- Cove Base Adhesive and **Black Asphaltic Material**
- Cementitious Panels at Eaves**
- 4"-6" Roof Vent Sealant/Flashing - Main Roof**
- Beige Paint w/Black Asphaltic Undercoat - Main Roof**
- 12'x12" Vent Flashing - Main Roof**
- Pipe Mount Flashing - Main Roof**
- Roof Vent Patch Material Black - Above 1st Floor Restroom**
- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 1st Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 1st Floor**
- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 2nd Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 2nd Floor**
- *Joint Adhesive/Sealant on Fiberglass Pipe Insulation, 3rd Floor**
- *Joint Adhesive/Sealant Fiberglass Pipe Insulation - Hangers, 3rd Floor**



III Survey Findings

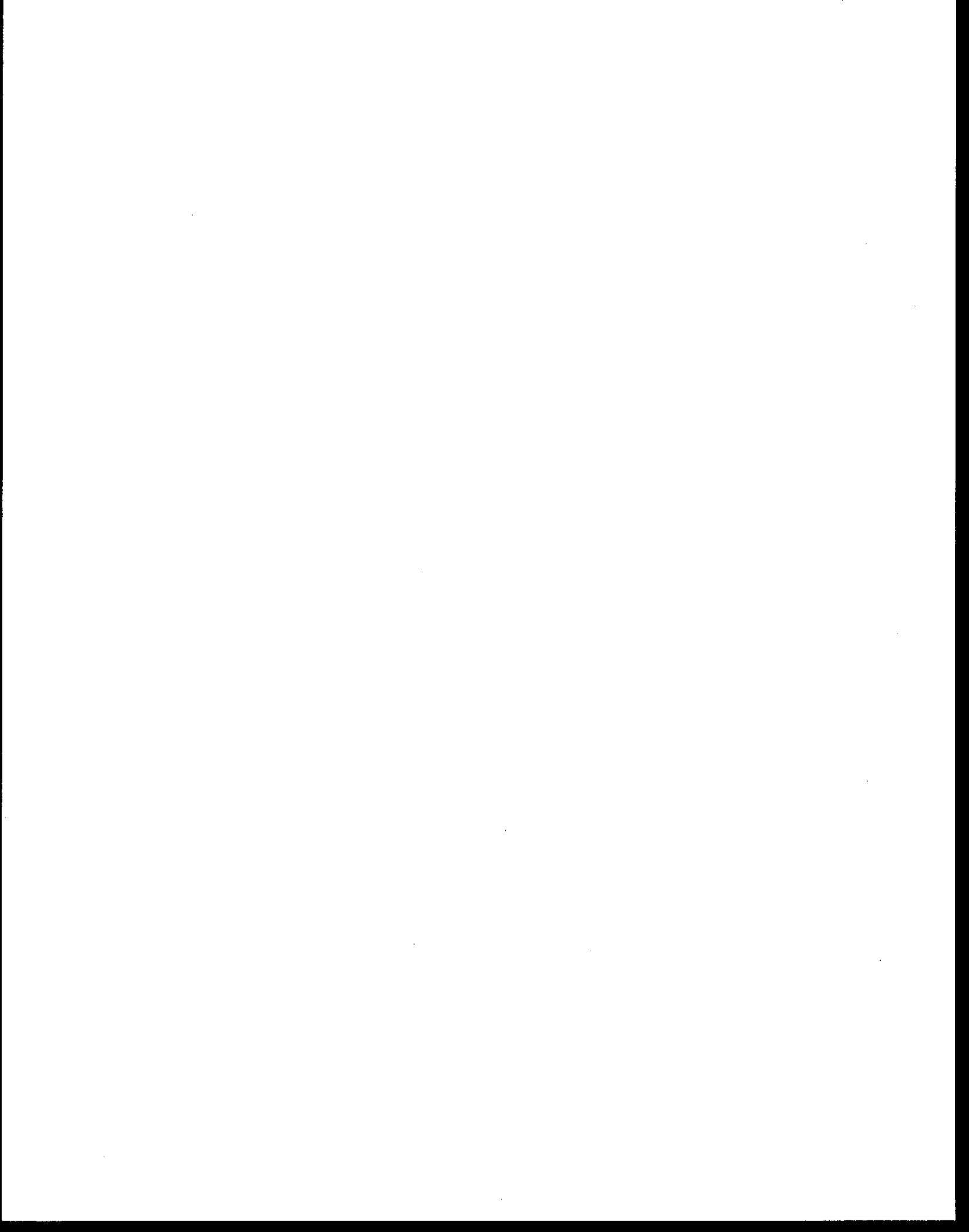
EKNAs inspectors, Christine Arouh, Steven Chun, William Harris, Prudy Stoudt-McRea, Kennyson Thomas and Doug Tisdell (see Appendix C for Inspector Certificates) identified eighty two (82) distinct material types and submitted two hundred fifty two (252) suspect samples for laboratory analysis. Material types sampled are listed below. Materials found to contain >1% asbestos are indicated in **bold** print, an asterisk indicates a friable or potentially friable material. Materials found to contain <1% asbestos are indicated in *italic* print.

12"x12" Vinyl Floor Tile (VFT) - Olive w/Olive Streaks and **Black Mastic**, 1st Floor
12"x12" VFT - Olive w/Olive Streaks and **Black Mastic**, 2nd Floor
12"x12" VFT - Olive w/Olive Streaks and **Black Mastic**, 3rd Floor
12"x12" VFT - Blue and **Black Mastic**, 1st Floor
12"x12" VFT - White w/Tan Specks and Brown Mastic, 1st Floor
12"x12" VFT - White w/Tan Streaks and **Black Mastic**, 2nd Floor
12"x12" VFT - White w/Tan Streaks and Brown Mastic, 3rd Floor
12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 1st Floor
12"x12" VFT - Dark Tan w/Brown Streaks and **Mastic**, 2nd Floor
12"x12" VFT - Light Tan w/Brown Streaks and Mastic, 1st Floor
12"x12" VFT - Light Tan w/Brown Streaks and Mastic, 2nd Floor
12"x12" VFT - Light Tan w/Brown Streaks and Mastic, 3rd Floor
12"x12" VFT - Grey w Dark Grey Specks and Mastic, 1st Floor
12"x12" VFT - Red w/Brown Streaks and Mastic, 1st Floor
12"x12" VFT - Light Grey w/Black Streaks and Mastic, 3rd Floor
12"x12" VFT - Black w/White Streaks and **Black Mastic**, 1st Floor
9"x9" VFT Green and **Black Mastic**, 1st Floor
Carpet Adhesive and **Mastic**
VFT - Tan and Black Mastic
VFT - Tan w/Olive Streaks and **Black Mastic**
VFT - Tan Streaked and **Black Mastic**
VFT - Rust/Brown Streaked and Black Mastic
VFT - Tan w/Light Brown Streaks and Black Mastic
VFT - Cream w/Light Brown Streaks and Black Mastic
VFT - Tan w/Light Brown/Cream Streaks and Black Mastic
Gypsum Wall Board and Joint Compound - White, 1st Floor
Gypsum Wall Board and Joint Compound - White, 2nd Floor
Gypsum Wall Board and Joint Compound - White, 3rd Floor
Gypsum Wall Board and Joint Compound - Brown, 2nd Floor
Gypsum Wall Board and Joint Compound - Brown, 3rd Floor
Cementitious Plaster - Troweled on CMU & Concrete Walls, 1st Floor
Cementitious - Plaster & Lathe Wall System, Community Restroom, 2nd Floor
Cementitious - Plaster & Lathe Wall System, Community Restroom, 3rd Floor
Cementitious Plaster-Hollow Plaster & Lathe Wall Sys. 2nd Flr (Private-Bathrooms),
see "Section IV - Remarks and Comments".



see "Section IV - Remarks and Comments".

Wall Insulation - Brown Fluffy Material - 1st Floor
 Wall Insulation - Brown Fluffy Material - 2nd Floor
 Wall Insulation - Brown Fluffy Material - 3rd Floor
 4" Cove Base - Black with Mastic
 4" Cove Base - Brown with Mastic
 4" Cove Base - Cream with Mastic
Cove Base Adhesive and Black Asphaltic Material
 2'x4' Ceiling Tile - Random Fissure Type I, 1st Floor
 2'x4' Ceiling Tile - Random Fissure Type I, 2nd Floor
 2'x4' Ceiling Tile - Random Fissure Type I, 3rd Floor
 2'x4' Ceiling Tile - Random Fissure Type II, 3rd Floor
 2'x4' Ceiling Tile - Long Fissure Pattern, 1st Floor
 2'x4' Ceiling Tile - Holes Fissure Pattern, 1st Floor
 2'x4' Ceiling Tile - Holes Fissure Pattern, 3rd Floor
 2'x4' Ceiling Tile - Pinholes Pattern, 1st Floor
 2'x4' Ceiling Tile - Pinholes Pattern, 2nd Floor
 2'x4' Ceiling Tile - Pinholes Pattern, 3rd Floor
Cementitious Eaves Panels
 Composition Built-up Roofing Material - Main
 2" Roof Vent Sealant/Flashing - Main Roof
4"-6" Roof Vent Sealant/Flashing - Main Roof
Beige Paint w/Black Asphaltic Undercoat - Main Roof
 Roof Hatch Flashing - Main Roof
 Flue Stack Flashing - Main Roof
12'x12" Vent Flashing - Main Roof
Pipe Mount Flashing - Main Roof
 Composition Built-up Roofing Material Type II - Lower Roof
 Composition Built-up Roofing Material Type II, Flashing - Lower Roof
 Composition Built-up Roofing Material Type III - Restrooms - Lower Roof
 Composition Built-up Roofing Material Type III, Flashing - Restrooms - Lower Roof
 Roof Access Hatchway Wall Board
Roof Vent Patch Material Black - Above 1st Floor Restroom
 HVAC Vibration Cloth - Black
 ***Joint Adhesive/Sealant** on Fiberglass Pipe Insulation, 1st Floor
 ***Joint Adhesive/Sealant** Fiberglass Pipe Insulation - Hangers, 1st Floor
 ***Joint Adhesive/Sealant** on Fiberglass Pipe Insulation, 2nd Floor
 ***Joint Adhesive/Sealant** Fiberglass Pipe Insulation - Hangers, 2nd Floor
 ***Joint Adhesive/Sealant** on Fiberglass Pipe Insulation, 3rd Floor
 ***Joint Adhesive/Sealant** Fiberglass Pipe Insulation - Hangers, 3rd Floor
 Fiberglass Duct Insulation w/Sealant, 1st Floor
 Fiberglass Duct Insulation w/Sealant, 2nd Floor
 Fiberglass Duct Insulation w/Sealant, 3rd Floor
 Pipe Hanger Insulation - Soft White Fibrous Material
 Cementitious Plaster - Building Exterior, 1st Floor



Cementitious Plaster - Building Exterior, 2nd Floor
Cementitious Plaster - Building Exterior, 3rd Floor

Heater Room

Hot Water Tank Insulation

Joint Adhesive/Sealant on Fiberglass Pipe Insulation

Joint Adhesive/Sealant on Fiberglass Pipe Insulation, Hangers

IV Remarks and Comments

Review "Volume III, Asbestos Survey, Analytical and Report for: Quad I - Buildings 847 and 855 "DIVARTY" Dining Facility - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

Although the following material types are not considered asbestos-containing materials, caution should be exercised if/when disturbing these materials. Proposed work methods which may involve sawing, cutting, drilling abrading, etc. of these materials should be evaluated for their potential for airborne asbestos fiber release.

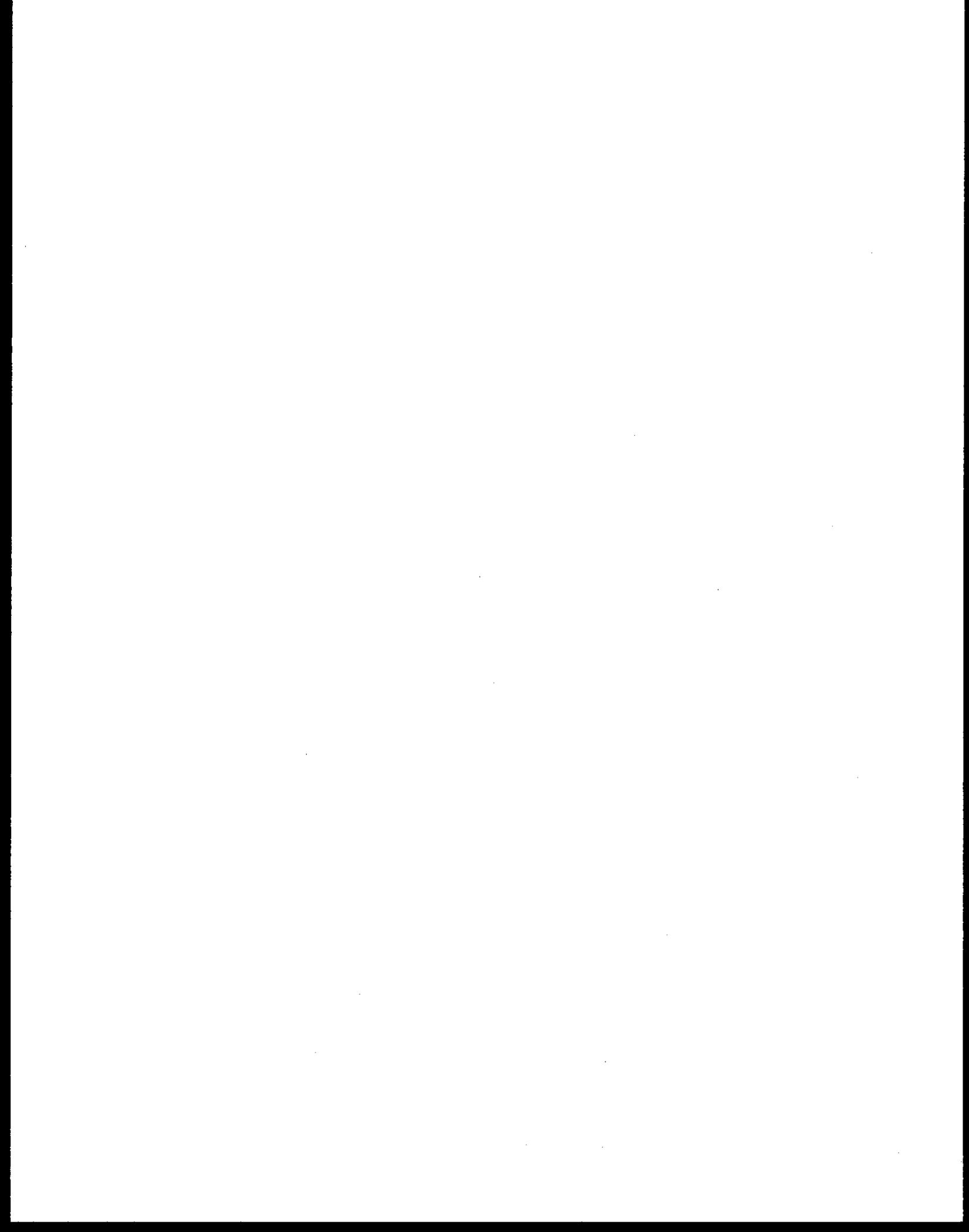
EKNA directed its analytical laboratory, NVL Laboratories of Seattle, to re-analyze the applicable samples by "NESHAP Point Count Method" for the following material types:

Cementitious Plaster-Hollow Plaster & Lathe Wall Sys. 2nd Flr (Private-Bathrooms)

Cementitious Plaster-Hollow Plaster and Lathe Wall Sys. 3rd Flr (Private Bathrooms)

Analytical results will be forwarded upon receipt.

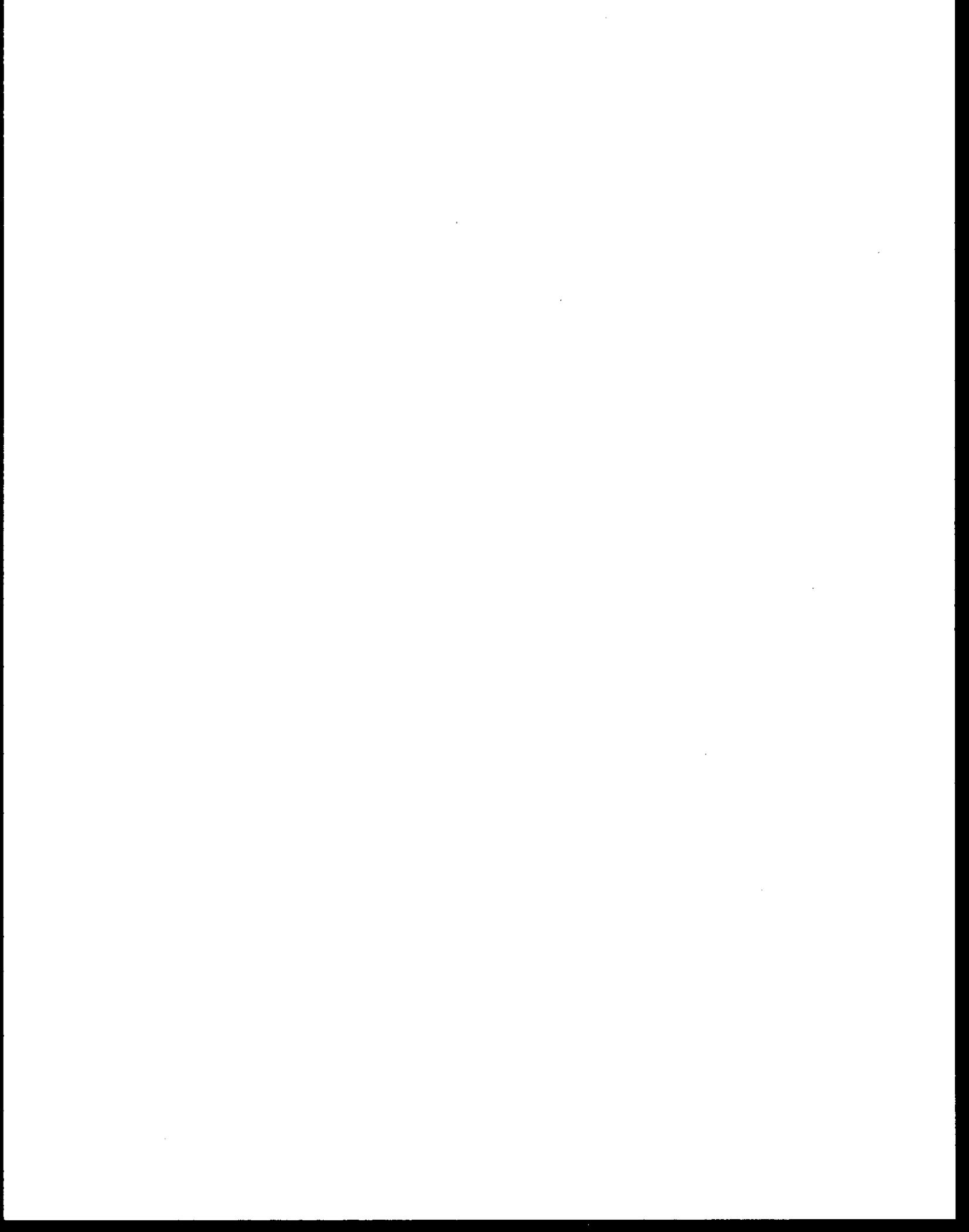
Further analysis of the *Exterior Plaster* and *Cementitious Plaster-Hollow Plaster and Lathe Wall Sys. 3rd Flr (Room Bathrooms)* by "NESHAP Point Count Method" indicates that these material types contains <1% asbestos and is considered non-regulated asbestos-containing materials, see "NESHAP Point Count Method Results"
"REMOVE BEFORE PRINTING"

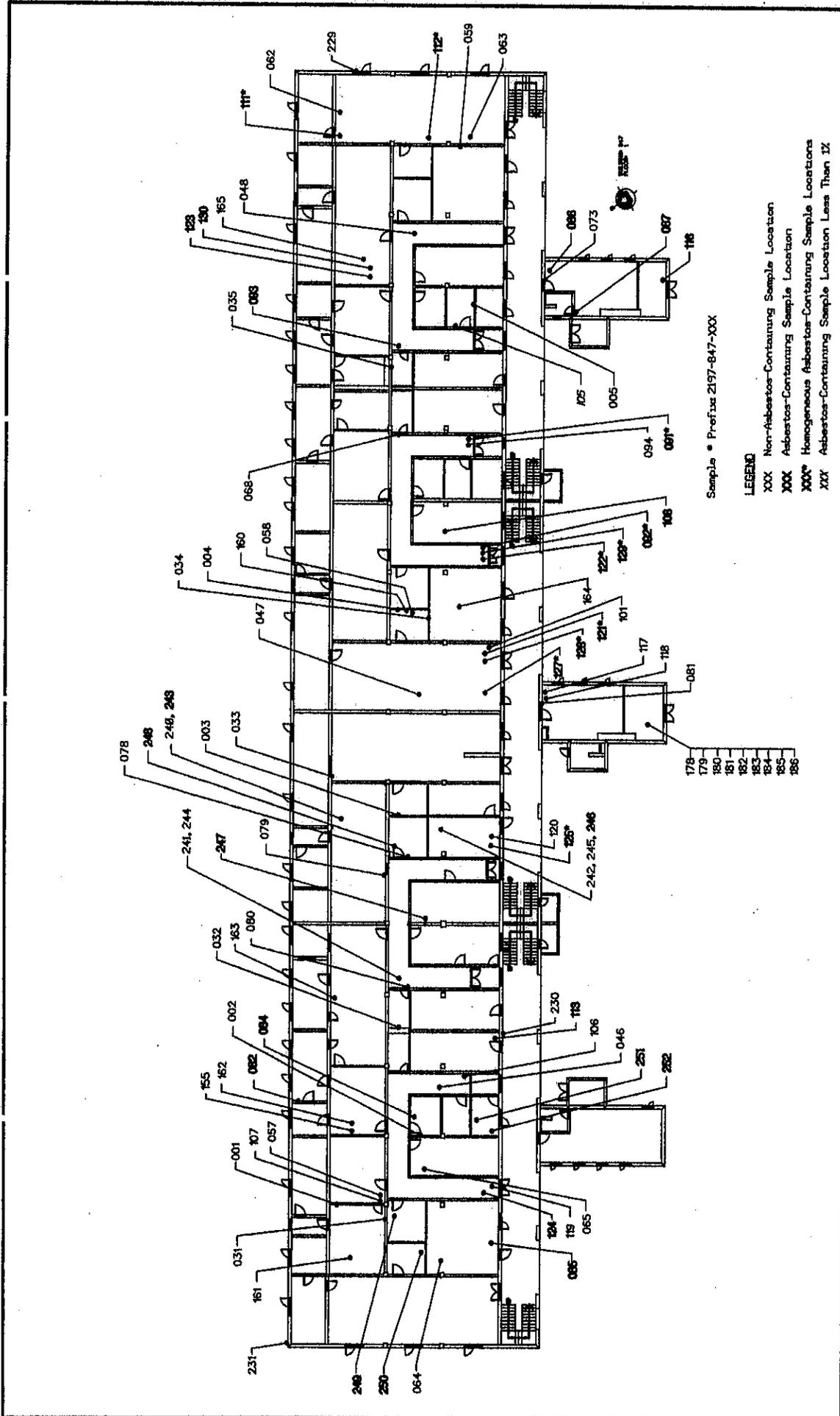


Building 847

**Sample Locations
and
Extent of Identified ACM
Drawings**

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii





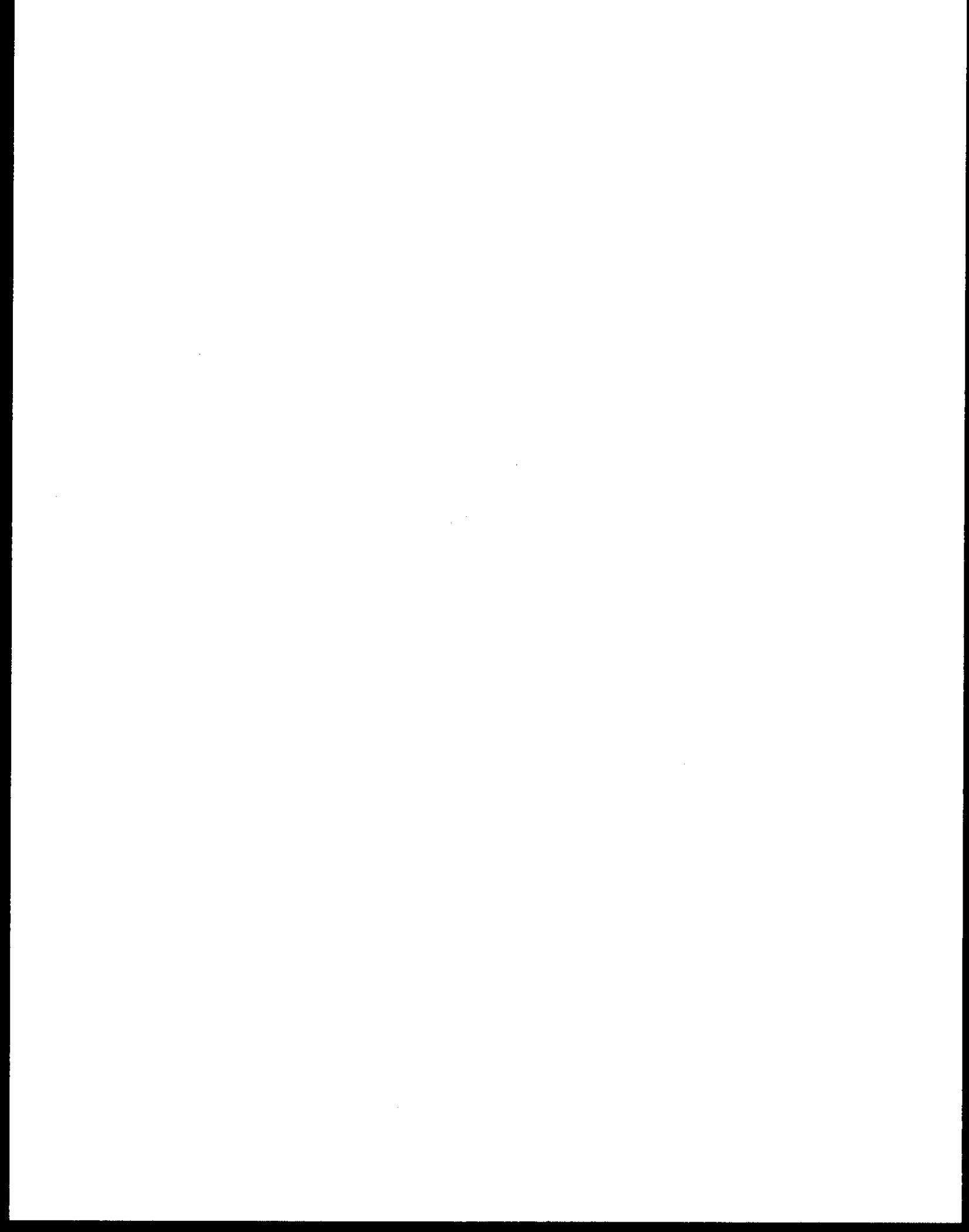
Edward K. Noda
 and Associates, Inc.
 615 PINE STREET SUITE 300 HONOLULU, HAWAII, 96813
 DRAWN BY: E. NODA DATE: 02-07-91

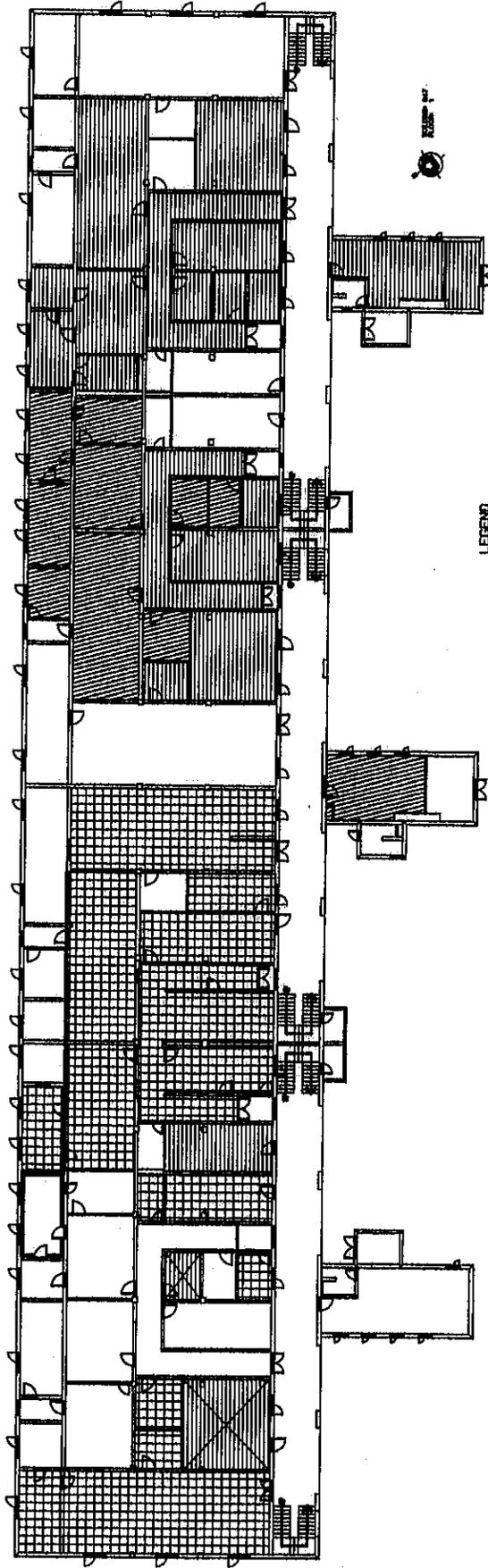
U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACAB3-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Sample Locations
 First Floor

Figure
 1





LEGEND

-  Asbestos-Containing Mastac Only (Single Layer)
-  Asbestos-Containing Mastac Only (Multiple Layer)
-  Asbestos-Containing Mastac Only (Single Layer Under Carpet)
-  Asbestos-Containing Floor Tile and Asbestos-Containing Mastac (Multi-Layer Floor Tile System)
-  Asbestos-Containing Cove Base and Black Adhesive

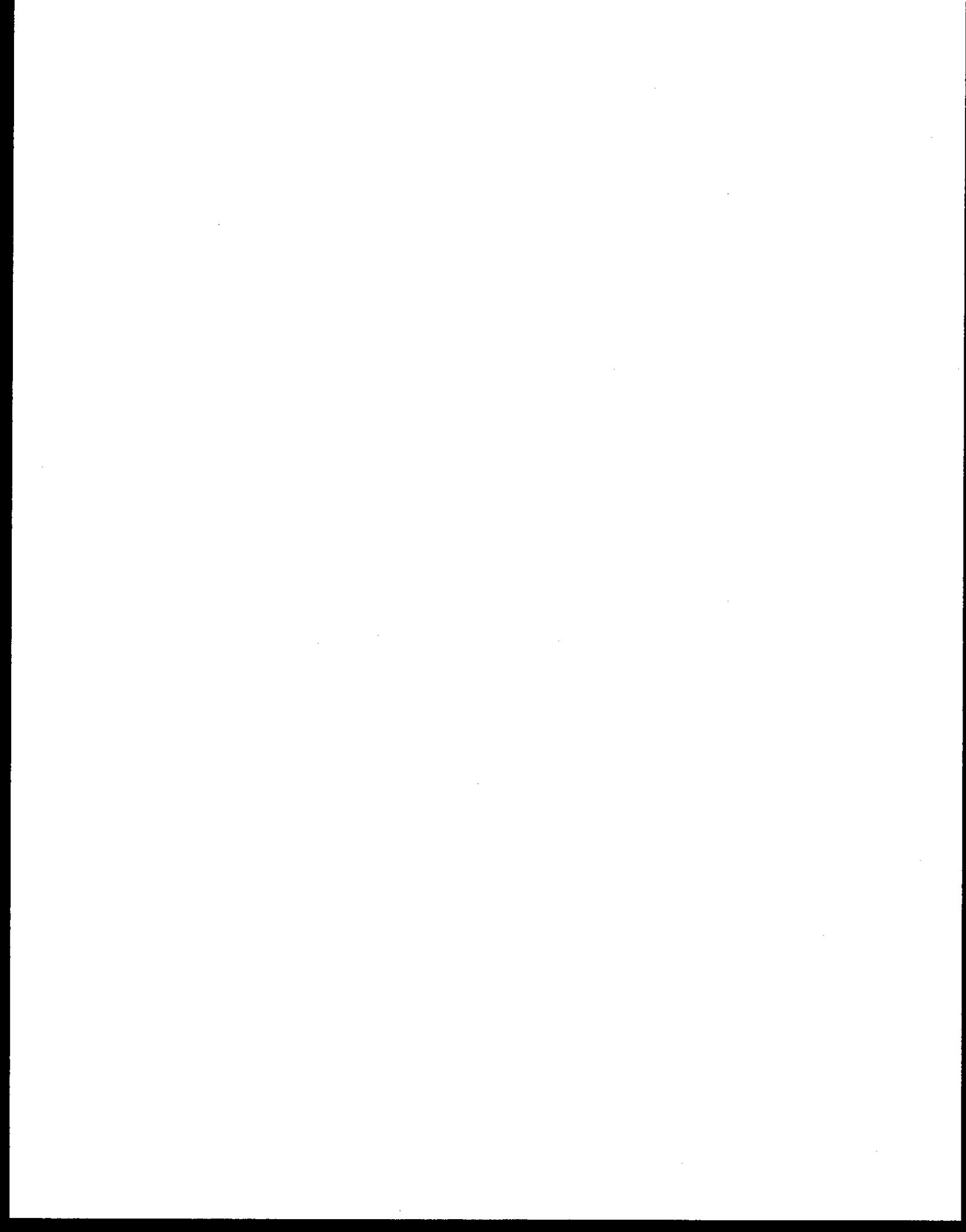
Edward K. Noda and Associates, Inc.
 65 PEARL STREET, SUITE 300, HONOLULU, HAWAII, 96804
 Drawn by: C. Ernie Date: 02-07-07

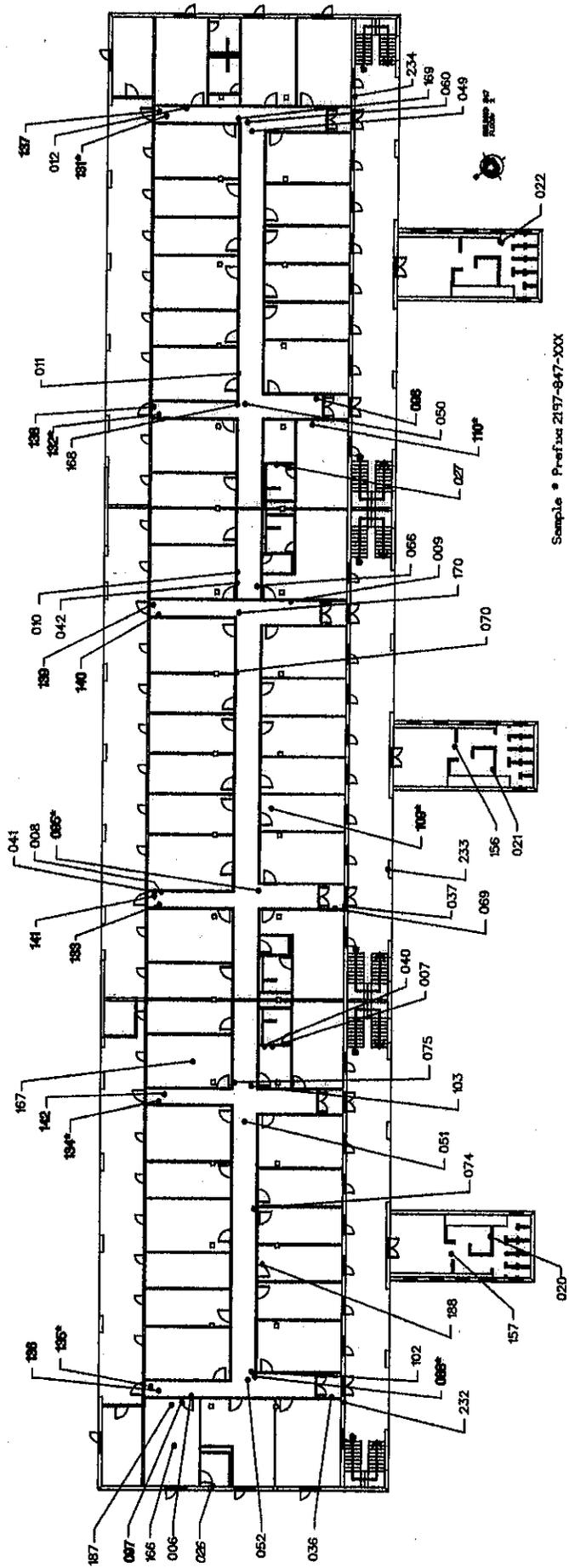
U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DAC483-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Extent of Identified ACM
 First Floor

Figure
 2

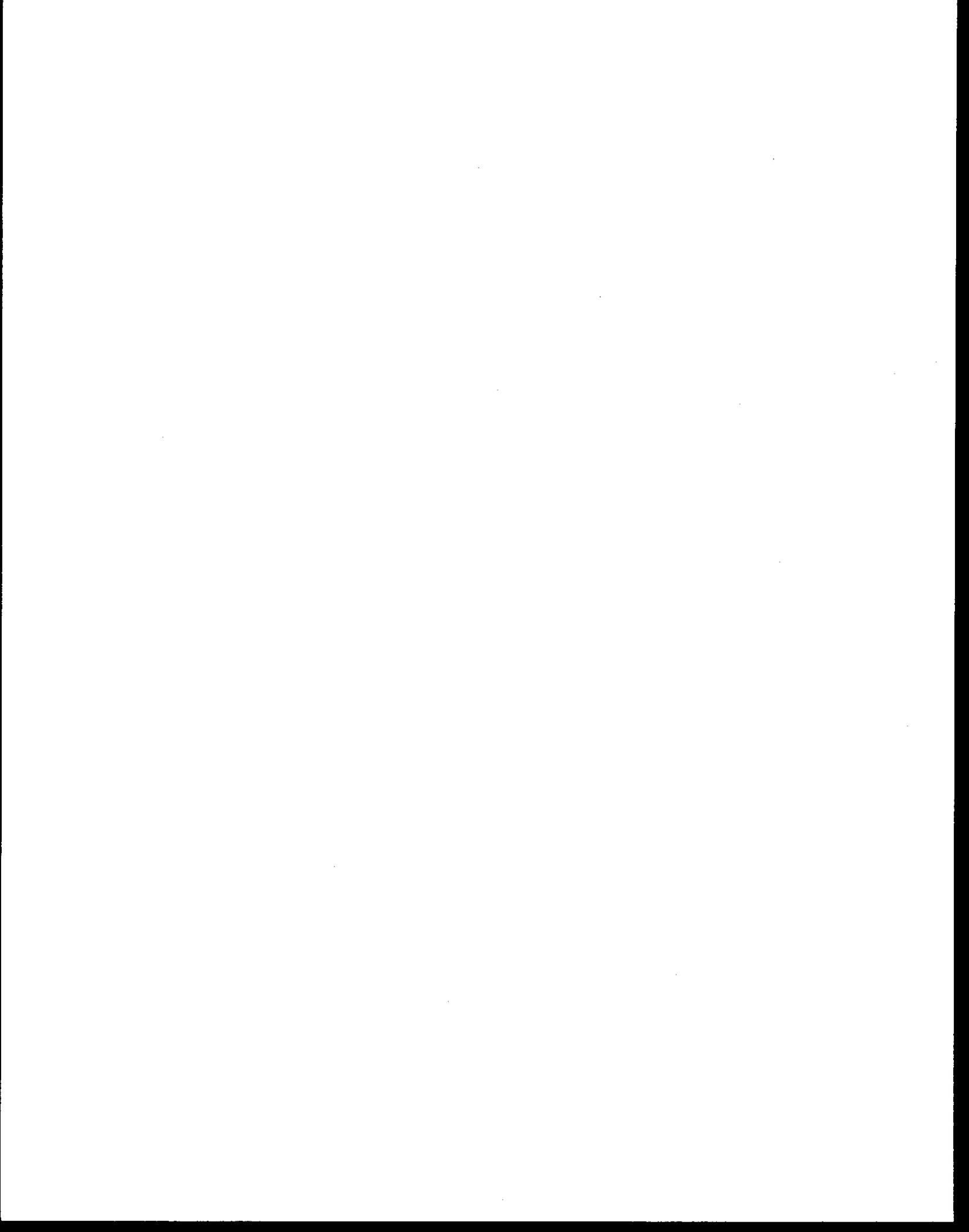


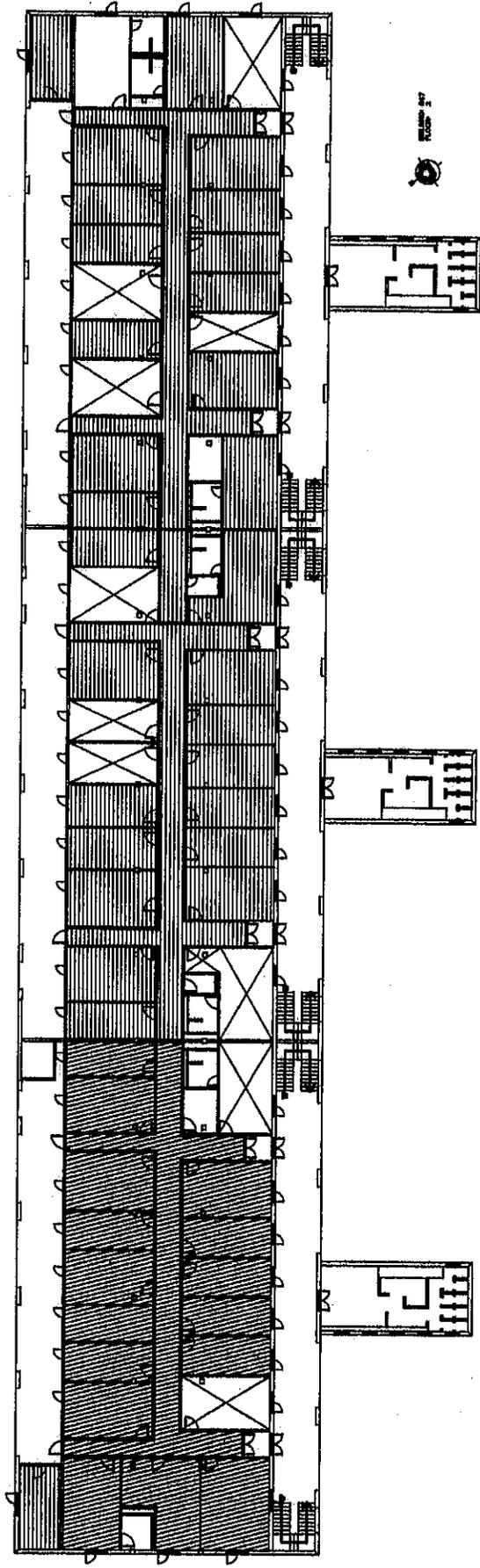


Sample * Prefix 2197-847-XXX

- LEGEND**
- XXX Non-Asbestos-Containing Sample Location
 - XXX Asbestos-Containing Sample Location
 - XXX* Homogeneous Asbestos-Containing Sample Locations
 - XXX Asbestos-Containing Sample Location Less Than 1%

<p>Edward K. Noda and Associates, Inc. 615 KING STREET SUITE 300 HONOLULU HAWAII 96814 Drawn by C. Arab Date: 02-07-01</p>	<p>U. S. Army Corps of Engineers, Pacific Ocean Division Fort Shafter, Oahu, Hawaii Contract No: DACAB3-00-D-0012, Task Order No: 0012</p>	<p>Asbestos Survey, Analysis and Report for Quad J, Building 847</p>	<p>Sample Locations Second Floor Figure 1</p>
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Note:

Asbestos-Containing Joint Adhesive Sealant (Of White/Yellow/Orange/Tan) On
 Fiberglass Pipe Insulation (Runs, Elbows, Tees, Fittings, Hangers
 and Saddles, etc ... Exists Throughout Floor.)

LEGEND

-  Asbestos-Containing Material Only (Single Layer)
-  Asbestos-Containing Material Only (Multiple Layer)
-  Rooms Unaccessible

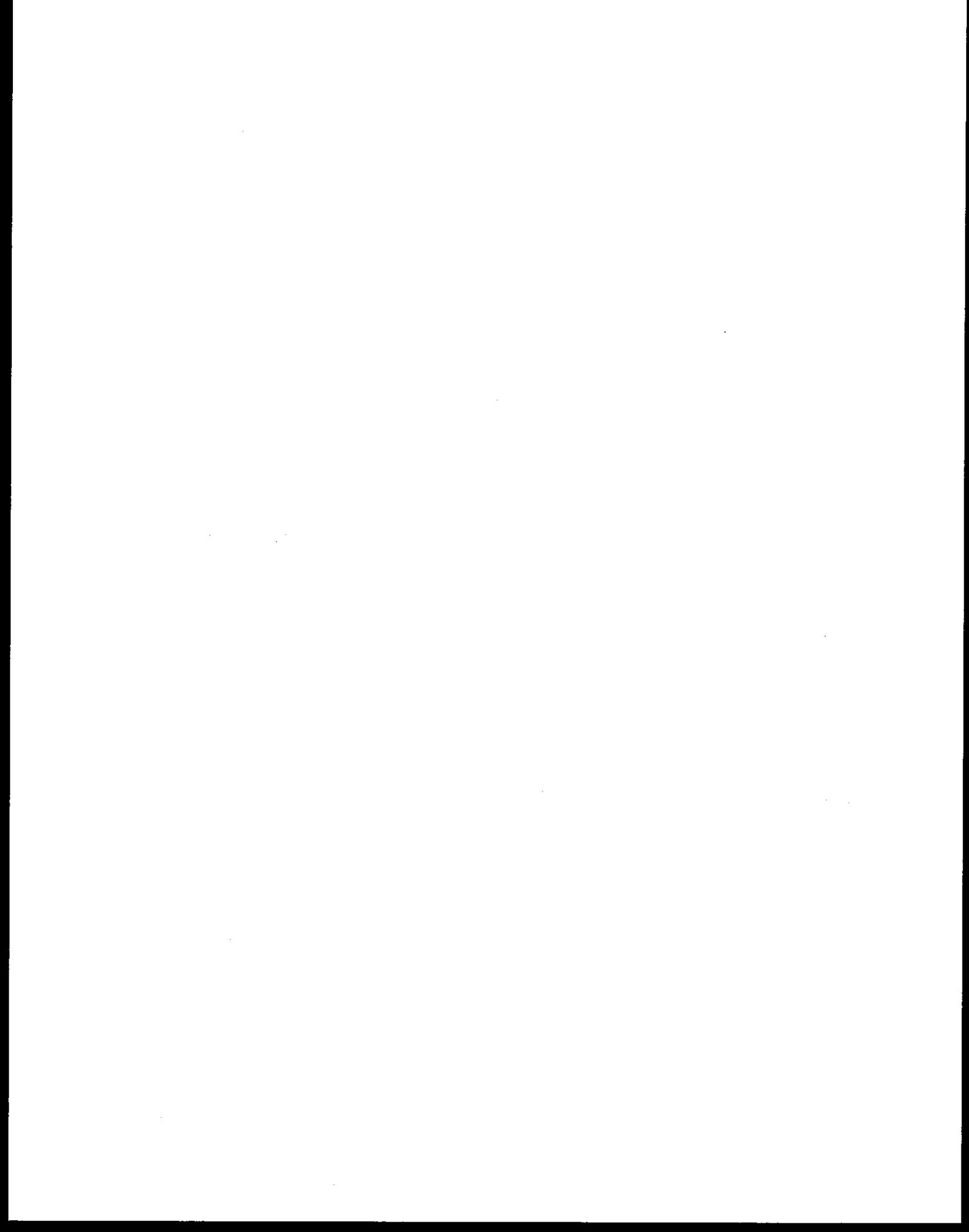
**Edward K. Noda
 and Associates, Inc.**
 515 KING STREET SUITE 300, HONOLULU, HAWAII, 96813
 Drawn by C. Arrish Date: 02-07-01

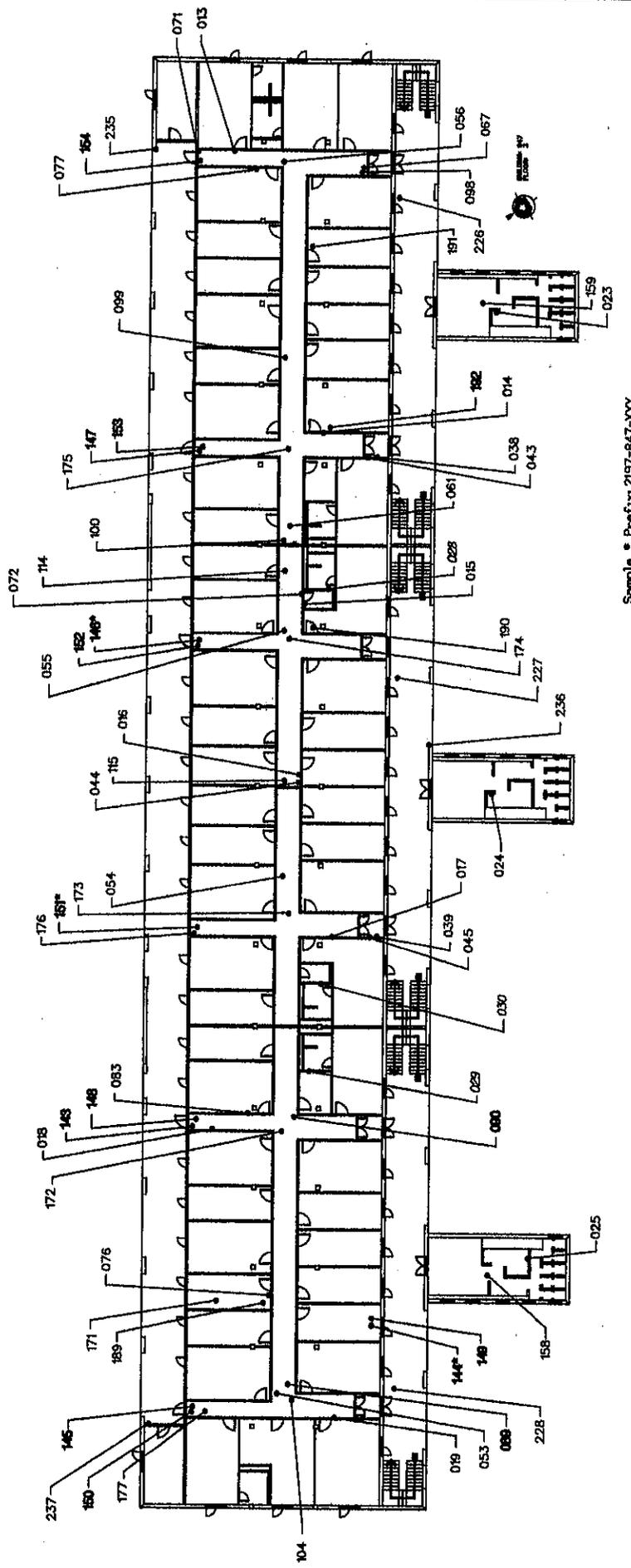
U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DAC-AB3-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Extent of Identified ACBM
 Second Floor

Figure
 2





Sample * Prefix 2197-847-XXX

LEGEND

- XXX Non-Asbestos-Containing Sample Location
- XXX Asbestos-Containing Sample Location
- XXX* Homogeneous Asbestos-Containing Sample Locations
- XXX Asbestos-Containing Sample Location Less Than 1%

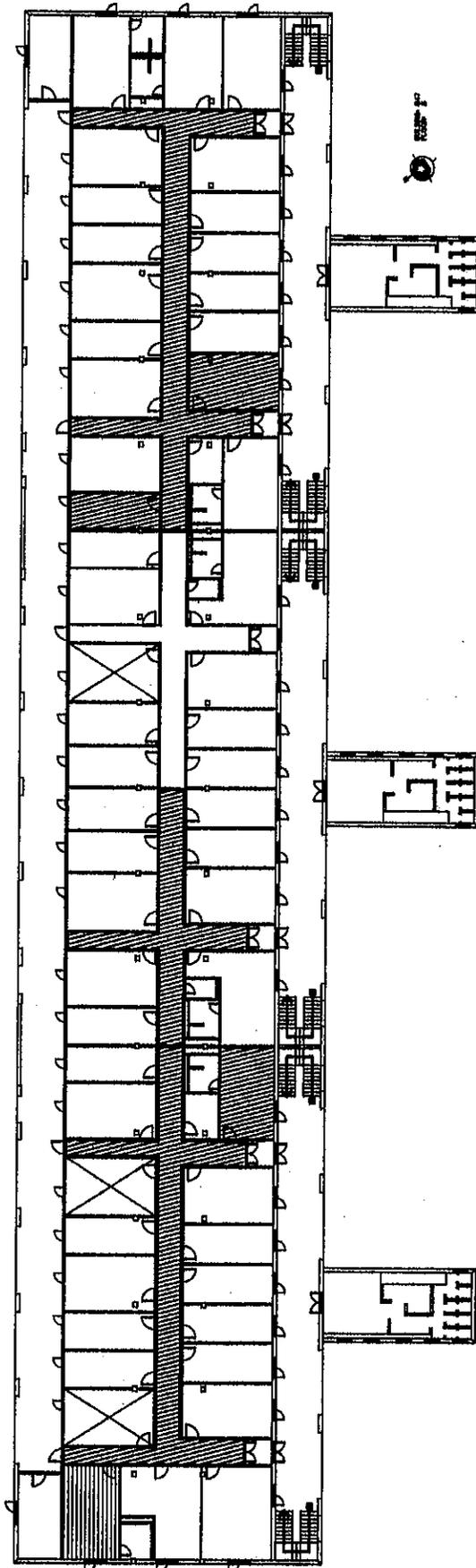
U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACA83-00-D-0012, Task Order No: 0012

Edward K. Noda and Associates, Inc.
 615 PEARL STREET SUITE 300, HONOLULU, HAWAII, 96814
 Phone: 813-441-1111 Fax: 813-441-1112

Sample Locations
 Third Floor

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Figure
 1



LEGEND

-  Asbestos-Containing Mastac Only (Single Layer)
-  Asbestos-Containing Mastac Only (Multiple Layer)
-  Rooms Unaccessible

Note:

Asbestos-Containing Joint Adhesive Sealant (Off White/Yellow/Orange/Tan) On
 Fiberglass Pipe Insulation (Runs, Elbows, Tees, Fittings, Hangers
 and Saddles, etc ... Exists Throughout Floor.)

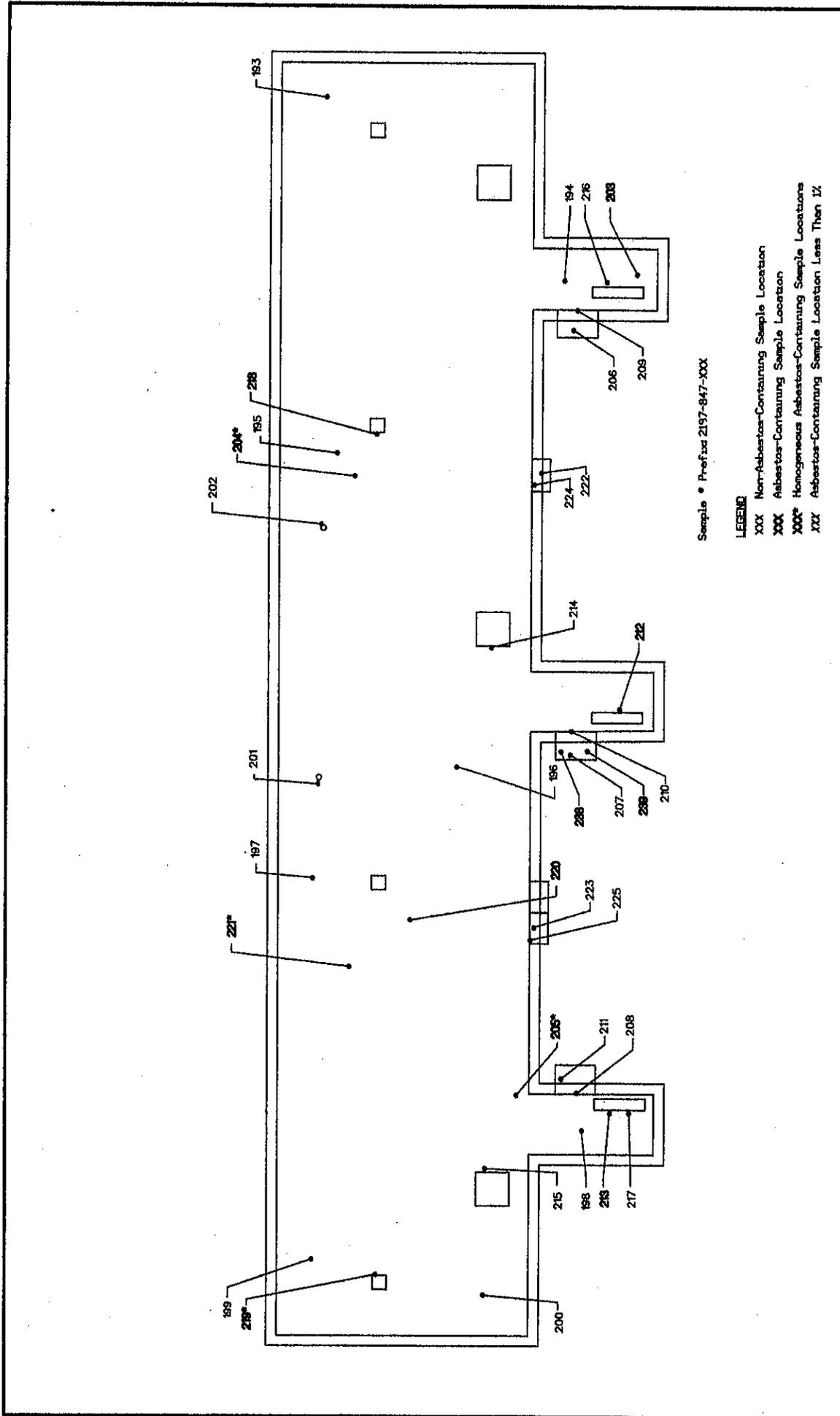
**Edward K. Noda
 and Associates, Inc.**
 615 FORT STREET SUITE 300, HONOLULU, HAWAII 96814
 Bruce Aye C. Archibald Date: 02-07-01

U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACA83-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Extent of Identified ACM
 Third Floor

Figure
 2

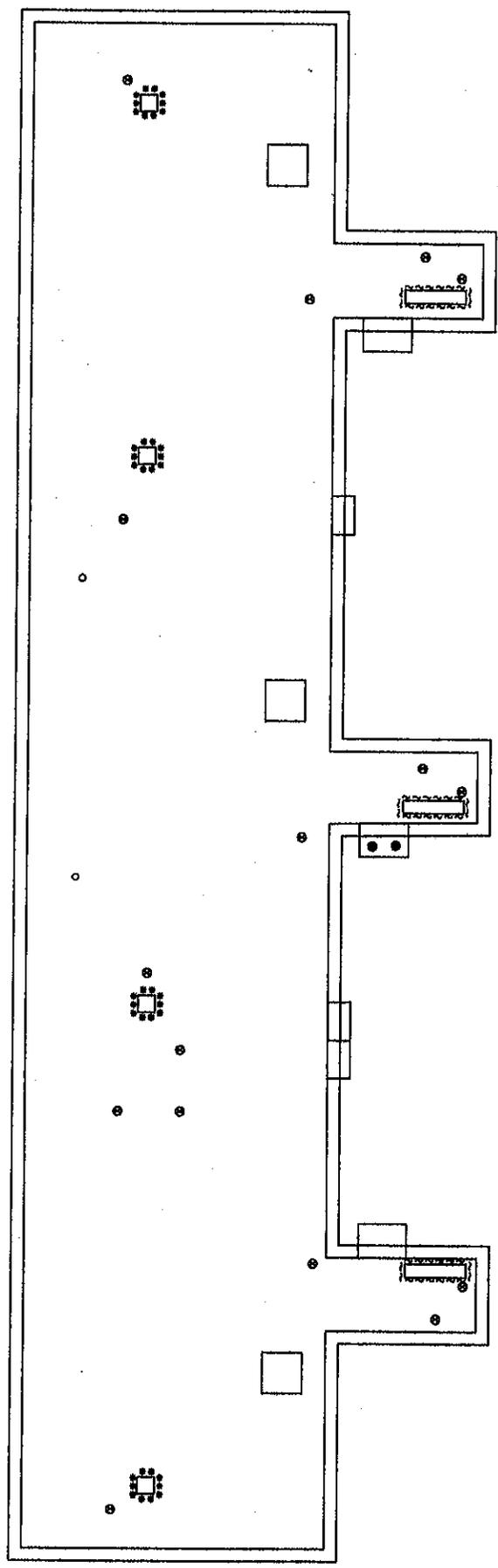


Sample • Prefix 2197-847-XXX

LEGEND

- XXX Non-Asbestos-Containing Sample Location
- XXX Asbestos-Containing Sample Location
- XXX* Homogeneous Asbestos-Containing Sample Locations
- XXX Asbestos-Containing Sample Location Less Than 1%

<p>Edward K. Noda and Associates, Inc. 85 FIVE STREET, SUITE 300, HONOLULU, HAWAII, 96814 Drawn by: C. Arach Date: 02-07-01</p>	<p>U. S. Army Corps of Engineers, Pacific Ocean Division Fort Shafter, Oahu, Hawaii Contract No: DACA83-00-D-0012, Task Order No: 0012</p>	<p>Asbestos Survey, Analysis and Report for Quad J, Building 847</p>	<p>Sample Locations Roof</p>	<p>Figure 1</p>
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LEGEND

- Asbestos-Containing Flashing/Sealant Gas Vents and Mount Points
- Asbestos-Containing Roof Vent Flash
- Asbestos-Containing Beige Paint w/Asphaltic Undercoat
- Asbestos-Containing 12 x 12 Vent Flashing

Edward K. Noda and Associates, Inc.
 615 HANAUER STREET SUITE 300, HONOLULU, HAWAII 96813
 Drawn by: C. A. Smith Date: 02-07-01

U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DAC-A83-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 847

Extent of Identified ACBM
 Roof

Figure
 2

Building 847
Quantity Tables

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

Quantity Tables for Building 847

	1 st Floor	2 nd Floor	3 rd Floor
Asbestos-Containing Mastic and Associated NON-Asbestos-Containing Floor Tile (Single-Layer-Layer)	4,905 sq'	8,335 sq'	285 sq'
Asbestos-Containing Mastic and Associated NON-Asbestos-Containing Floor Tile (Multi-Layer)	2,290 sq'	4,755 sq'	3,025 sq'
Asbestos-Containing Floor Tile and Mastic (Multi-Layer)	2,260 sq'		
Asbestos-Containing Mastic (Under Carpet)	540 sq'		

	Total Quantity
Cove Base w/associated Asbestos-Containing Mastic	60 ln'

	Total Quantity
Cementitious Panels at Eaves	3,500 sq'
4"-6" Roof Vent Sealant/Flashing - Main Roof (12 @ 1.5 sq' each)	18 sq'
Pipe Mount Flashing - Main Roof (3 @ 1sq' each)	3 sq'
12"x12" Vent Flashing - Main Roof (4 @ 9 sq' each)	36 sq'
Beige Paint w/Black Asphaltic Undercoat - Main Roof	480 sq'
Roof Vent Patch Material Black - Above 1st Floor Restroom	10 sq'

Joint Adhesive/Sealant on Fiberglass Pipe Insulation	Outside Diameter	1 st Floor	2 nd Floor	3 rd Floor
	2"	110 ln'	445 ln'	800 ln'
	3"	400 ln'	1,450 ln'	1,880 ln'
	4"	170 ln'	400 ln'	
	6"	20 ln'	80 ln'	80 ln'
	Total Per Floor	700 ln'	2375 ln'	2760 ln'

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Hangers	Outside Diameter	1 st Floor	2 nd Floor	3 rd Floor
	2"	12 ea.	46 ea.	82 ea.
	3"	40 ea.	150 ea.	190 ea.
	4"	18 ea.	42 ea.	
	6"	4 ea.	10 ea.	10 ea.
	Total Per Floor	74 ea.	248 ea.	282 ea.

Building 847

Floor Tile Log

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

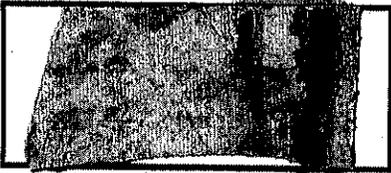
BUILDING 847 FLOOR TILE LOG



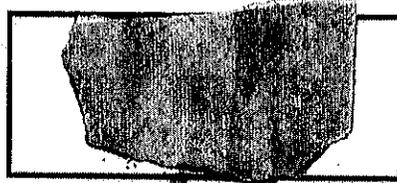
12" X 12" Vinyl Floor Tile
Olive w/Olive Streaks



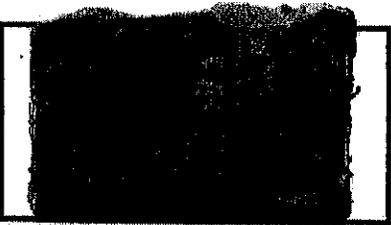
12" X 12" Vinyl Floor Tile
Blue



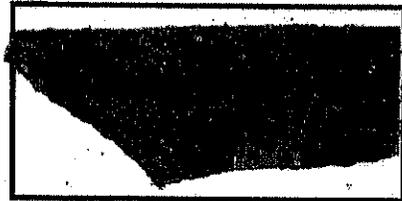
12" X 12" Vinyl Floor Tile
White w/Tan Streaks



12" X 12" Vinyl Floor Tile
Light Tan w/ Brown Streaks



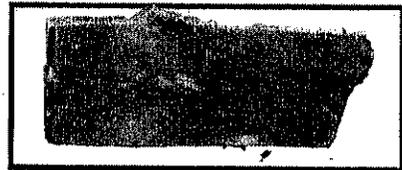
12" X 12" Vinyl Floor Tile
Grey w/Dark Grey Specks



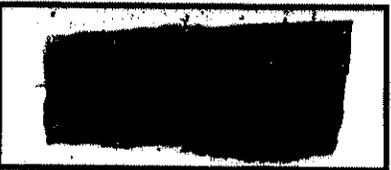
12" X 12" Vinyl Floor Tile
Dark Tan w/Brown Streaks



9" X 9" Vinyl Floor Tile
Green



12" X 12" Vinyl Floor Tile
Light Grey w/Black Streaks



12" X 12" Vinyl Floor Tile
Black w/White Streaks



12" X 12" Vinyl Floor Tile
Red w/Brown Streaks

Please Note: Materials found to contain >1% asbestos are indicated in **bold** print.

Building 847

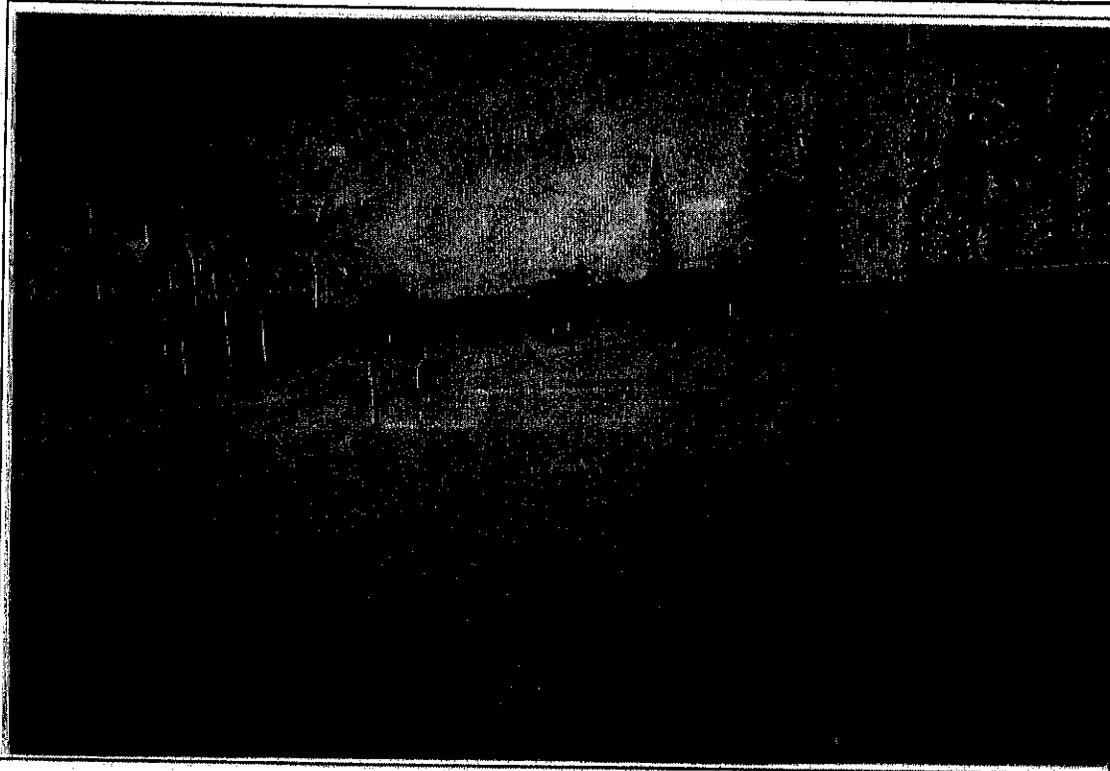
Photo Log

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

BUILDING 847 - PHOTO LOG



4"-6" Roof Vent Sealant/Flashing - Main Roof
Beige Paint w/Black Asphaltic Undercoat - Main Roof



12"x12" Vent Flashing - Main Roof
Pipe Mount Flashing - Main Roof

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 1 of 1

Building 847

**Chain of Custody Forms
and
Asbestos Bulk Analysis Forms**

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE

CHAIN OF CUSTODY FORM

21-01355

SHEET 1 OF 20

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-001	B	1	OFFICE	Gypsum Wallboard w/ Joint Compound - 1st Floor
2	2197-847-002	B	1	OFFICE	" " " " " "
3	2197-847-003	B	1	OFFICE	" " " " " "
4	2197-847-004	B	1	STORAGE ROOM	" " " " " "
5	2197-847-005	B	1	OFFICE	" " " " " "
6	2197-847-006	B	2	HALLWAY	Gypsum Wallboard w/ Joint Compound - 2nd Floor
7	2197-847-007	B	2	UTILITY ROOM	" " " " " "
8	2197-847-008	B	2	HALLWAY	" " " " " "
9	2197-847-009	B	2	HALLWAY	" " " " " "
10	2197-847-010	B	2	HALLWAY	" " " " " "

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102							
3446							
3447							
3448							
3449							
3450							
3451							
3452							
3453							
3454							
3455							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SDG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01350
 CLIENT NAME: Will Cree / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Atouh
 SIGNATURE: _____
 DATE: 2/28/01 TIME COMPLETED: _____ DATE: 2/28/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/28/01 TIME: 2:00 PM INITIALS: TC
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

SHEET 2 OF 20

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-011	B	2	HALLWAY	Gypsum wallboard w/ Joint Compound - 2nd Floor
2	2197-847-012	B	2	HALLWAY	" " " "
3	2197-847-013	B	3	HALLWAY	Gypsum Wallboard w/ Joint Compound - 3rd Floor
4	2197-847-014	B	3	HALLWAY	" " " "
5	2197-847-015	B	3	UTILITY ROOM	" " " "
6	2197-847-016	B	3	HALLWAY	" " " "
7	2197-847-017	B	3	HALLWAY	" " " "
8	2197-847-018	B	3	HALLWAY	" " " "
9	2197-847-019	B	3	HALLWAY	" " " "
10	2197-847-020	B	2	Rest Room	Cementitious - Plaster & Lath Wall System - 2nd Floor

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1	102						
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/T = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01350
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Churn, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/10/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/10/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 9:00 AM INITIALS: TC
 ANALYZED BY: _____
 LAB O.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

SHEET 3 OF 20

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-021	B	2	RESTROOM	Cementitious - Plaster & Lath wall System
2	2197-847-022	B	2	RESTROOM	" " " " " "
3	2197-847-023	B	3	RESTROOM	Cementitious Plaster & Lath wall System - white, 3rd Floor
4	2197-847-024	B	3	RESTROOM	" " " " " "
5	2197-847-025	B	3	RESTROOM	" " " " " "
6	2197-847-026	B	2	27B RR	Cementitious Plaster wall System Personnel
7	2197-847-027	B	2	222-RR	" " " " " (Brown Paint Room)
8	2197-847-028	B	3	327 RR	" " " " " "
9	2197-847-029	B	3	354 RR	" " " " " "
10	2197-847-030	B	3	349 RR	" " " " " "

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102							
3466							
3467							
3468							
3469							
3470							
3471							
3472							
3473							
3474							
3475							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SDT = SURFACE DUST - TAPE SAMPLE
 SDV = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNAD1360
 CLIENT NAME: Willi Chee / Corp of Engineers
 SAMPLERS NAME: K. Thomas, W. Harris, S. Chiu, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/1/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/1/01 TIME: _____ INITIALS: JS
 ANALYZED BY: _____
 LAB O.C. APPROVAL: _____
 DATE: 2/1/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

SHEET 7 OF 26

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-031	B	1	OFFICE	Cementitious Plaster - Travelled on CMP & Concrete walls - 1st Fl.
2	2197-847-032	B	1	JANITOR ROOM	
3	2197-847-033	B	1	OFFICE	
4	2197-847-034	B	1	STORAGE ROOM	
5	2197-847-035	B	1	JANITOR ROOM	
6	2197-847-036	B	2	ENTRY WAY	Gypsum Wallboard + Joint Compound - Brown
7	2197-847-037	B	2	ENTRY WAY	
8	2197-847-038	B	3	ENTRY WAY	
9	2197-847-039	B	3	ENTRY WAY	
10	2197-847-040	B	2	UTILITY ROOM	WALL Insulation - Fiberglass Material - 2nd Fl.

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
202 3476							
3477							
3478							
3479							
3480							
3481							
3482							
3483							
3484							
3485							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDIT = SURFACE DUST - TAPE SAMPLE
- SDN = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Aroah
 SIGNATURE: _____
 DATE: 20/01 TIME COMPLETED: _____ DATE: 2/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00 PM INITIALS: TB
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-051	B	2	HALLWAY	2'x4' Ceiling Tile - Random Fissure Type I - 2nd Fl
2	2197-847-052	B	2	HALLWAY	
3	2197-847-053	B	3	HALLWAY	
4	2197-847-054	B	3	HALLWAY	
5	2197-847-055	B	3	HALLWAY	
6	2197-847-056	B	3	HALLWAY	
7	2197-847-057	B	1	OFFICE	2'x4' Ceiling Tile - Hole Fissure Pattern - 1st Fl
8	2197-847-058	B	1	STORAGE ROOM	
9	2197-847-059	B	1	103	
10	2197-847-060	B	2	HALLWAY	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1	2102						
2	3496						
3	3497						
4	3498						
5	3499						
6	3500						
7	3501						
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNAD1360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chur, D. Tisdell, C. Arouh.
 SIGNATURE: _____
 DATE: 2/21/01 TIME COMPLETED: _____ DATE: 2/1/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NMI Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/19/01 TIME: 2:00 PM INITIALS: JTS
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____ DATE: 2/21/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

21-01356 SHEET 6 OF 20

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-051	B	2	HALLWAY	2'x4' Ceiling Tile - Random Fissure Type I - 2nd Fl
2	2197-847-052	B	2	HALLWAY	
3	2197-847-053	B	3	HALLWAY	
4	2197-847-054	B	3	HALLWAY	
5	2197-847-055	B	3	HALLWAY	
6	2197-847-056	B	3	HALLWAY	
7	2197-847-057	B	1	OFFICE	2'x4' Ceiling Tile - Hole Fissure Pattern - 1st Fl
8	2197-847-058	B	1	STORAGE ROOM	
9	2197-847-059	B	1	102	
10	2197-847-060	B	2	HALLWAY	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

ACCOUNTABILITY RECORD

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/T = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNAD1360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/10/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FEDEX DATE: 2/10/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/10/01 TIME: _____
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 4/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM 21-01356 SHEET 1 OF 20

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-081	B	1	Central area	Covebase Adhesive - 1 st Floor
2	2197-847-082	B	1	North office	- 1 st Floor
3	2197-847-083	B	3	Room 3358	- 3 rd Floor
4	2197-847-084	B	1	North office	Carpet Adhesive - 1 st Floor
5	2197-847-085	B	1	West office	-
6	2197-847-086	B	1	Sensory office	12"x12" VETEX mastic - Olive w/ Olive Straks - 1st Fl.
7	2197-847-087	B	1	Sensory office	
8	2197-847-088	B	2	May Room 271	
9	2197-847-089	B	3	May Room 371	
10	2197-847-090	B	3	May Room 556	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1	2102 - 3527						
2	3528						
3	3529						
4	3530						
5	3531						
6	3532						
7	3533						
8	3534						
9	3535						
10	3536						

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/T = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K Thomas, W Harris, S Chun, D Tisdell, C Arouh
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/1/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00 PM INITIALS: TG
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

21-01356 SHEET 10 OF 20

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-091	B	1	Hallway	12" x 12" VET w/mastic - Blue - 1st FL
2	2197-847-092	B	1	Hallway	
3	2197-847-093	B	1	east hallway	
4	2197-847-094	B	1	Hallway	12" x 12" VET w/mastic - white w/ten streaks - 1st FL
5	2197-847-095	B	2	Near Room 275	- 2nd FL
6	2197-847-096	B	2	east hallway	
7	2197-847-097	B	2	Room 278	
8	2197-847-098	B	3	east hallway	- 3rd FL
9	2197-847-099	B	3	east hallway	
10	2197-847-100	B	3	Near Room 326	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102							
3537							
3538							
3539							
3540							
3541							
3542							
3543							
3544							
3545							
3546							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arough
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/01/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 8:00 PM INITIALS: J.B.
 ANALYZED BY: S.P. M.
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

21-01357

SHEET 12 OF 20

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-111	B	1	Room 111	9" x 9" VET w/ mastic - Green - 1st Fl.
2	2197-847-112	B	1	Room 101	↓
3	2197-847-113	B	1	West office	↓
4	2197-847-114	B	3	Central Hallway	12" x 12" VET w/ mastic - Light Grey w/ Black streaks - 3rd Fl. (8)
5	2197-847-115	B	3	Central Hallway	↓
6	2197-847-116	B	1	Sensory Office	12" x 12" VET w/ mastic - Black w/ white streaks - 1st (10)
7	2197-847-117	B	1	Training office	12" x 12" VET w/ mastic - Red w/ brown streaks - 1st (11)
8	2197-847-118	B	1	Training office	↓
9	2197-847-119	B	1	Plenum	Fiberglass Pipe Insulation - Hangers - 1st Fl.
10	2197-847-120	B	1	Plenum	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2107							
3557							
3558							
3559							
3560							
3561							
3562							
3563							
3564							
3565							
3566							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDM = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K Thomas, W Harris, S Chun, D Tisdell, C Arduth
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/1/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:55 PM INITIALS: KC
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 3/4/01

APPROVAL SIGNATURE (PROJECT MANAGER): _____

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM 21-01357 SHEET 1 OF 20

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-121	B	1	Plenum	Fiberglass Pipe Insulation - Hangers - 1st FL
2	2197-847-122	B	1		
3	2197-847-123	B	1		
4	2197-847-124	B	1		Fiberglass Pipe Insulation w/ Joint Sealant - 1st FL
5	2197-847-125	B	1		
6	2197-847-126	B	1		
7	2197-847-127	B	1		
8	2197-847-128	B	1		
9	2197-847-129	B	1		
10	2197-847-130	B	1	Plenum	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2107 13567							
13568							
13569							
13570							
13571							
13572							
13573							
13574							
13575							
13576							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNAD1360
 CLIENT NAME: Wili Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W Harris, S Chun, D Tisdell, C Arouh
 SIGNATURE: _____
 DATE: 2/10/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: _____ DATE: 2/10/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/10/01 TIME: 2:13 PM INITIALS: TB
 ANALYZED BY: _____
 LAB O.C. APPROVAL: _____
 DATE: 2/10/01

APPROVAL SIGNATURE (PROJECT MANAGER):

Write Forward later

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

2101357 SHEET 13 OF 20

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-131	B	2	Plenum	Fiberglass Pipe Insulation - Hangers - 2nd Fl.
2	2197-847-132	B	2		
3	2197-847-133	B	2		
4	2197-847-134	B	2		
5	2197-847-135	B	2		
6	2197-847-136	B	2		
7	2197-847-137	B	2		
8	2197-847-138	B	2		
9	2197-847-139	B	2		
10	2197-847-140	B	2	Plenum	Fiberglass Pipe Insulation w/ Joint Sealant - 2nd Fl.

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
0102 3577							
3578							
3579							
3580							
3581							
3582							
3583							
3584							
3585							
3586							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arosin
 SIGNATURE: _____
 DATE: 2/9/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/1/01

LAB NAME: NMI Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/19/01 TIME: 2:00P INITIALS: TS
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 3/9/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

21-01357 SHEET 14 OF 20

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
33	2197-847-141	B	2	Plenum	Fiberglass Pipe Insulation w/ Joint Sealant - 2nd Fl.
↓	2197-847-142	B	2		↓
34	2197-847-143	B	3		Fiberglass Pipe Insulation - Hangers - 3rd Fl.
↓	2197-847-144	B	3		↓
↓	2197-847-145	B	3		↓
↓	2197-847-146	B	3		↓
↓	2197-847-147	B	3		↓
35	2197-847-148	B	3		Fiberglass Pipe Insulation w/ Joint Sealant - 3rd Fl.
↓	2197-847-149	B	3		↓
35	2197-847-150	B	3	Plenum	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
0102 3587							
3588							
3589							
3590							
3591							
3592							
3593							
3594							
3595							
3596							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 -10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/1/01 TIME: 2:00 PM INITIALS: TS
 ANALYZED BY: SE NL
 LAB Q.C. APPROVAL: _____
 DATE: 2/9/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

21-01357 SHEET 15 OF 20

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-151	B	3	Plenum	Fiberglass Pipe Insulation w/ Joint Sealant - 3rd Fl.
2	2197-847-152	B	3		
3	2197-847-153	B	3		
4	2197-847-154	B	3		
5	2197-847-155	B	1	Plenum	HVAC Vibration Cloth - Black
6	2197-847-156	B	2	RESTROOM	Acc. Ceiling Tile - Bandana. Fissure Type II - 2nd Fl.
7	2197-847-157	B	3	RESTROOM	
8	2197-847-158	B	3	RESTROOM	
9	2197-847-159	B	3	RESTROOM	
10	2197-847-160	B	1	STORAGE ROOM	WALL Insulation - Brown Fiberglass material

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	JR	COMMENTS
2102 3597							
3598							
3599							
3600							
3601							
3603							
3604							
3605							
3606							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 -10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____ DATE: 2/1/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/07 TIME: 2:20 PM INITIALS: JS
 ANALYZED BY: ST AL
 LAB Q.C. APPROVAL: _____
 DATE: 3/9/10

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM 32 21-01358 SHEET 16 OF 20

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-161	B	1	Plenum	Fiberglass Duct Insulation w/ Sealant - 1st Floor
2	2197-847-162	B	1		
3	2197-847-163	B	1		
4	2197-847-164	B	1		
5	2197-847-165	B	1		
6	2197-847-166	B	2		Fiberglass Duct Insulation w/ Sealant - 2nd Floor
7	2197-847-167	B	2		
8	2197-847-168	B	2		
9	2197-847-169	B	2		
10	2197-847-170	B	2	Plenum	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102 3607							
3608							
3609							
3610							
3611							
3612							
3613							
3614							
3615							
3616							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SDG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKN01360
 CLIENT NAME: W&H Chee / Corp of Engineers
 SAMPLER'S NAME: K Thomas, W Harris, S Chun, D Tisdell, C Arouh
 SIGNATURE: _____
 DATE: 2/10/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/10/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00PM INITIALS: JG
 ANALYZED BY: SC NL
 LAB Q.C. APPROVAL: 2/28/01
 DATE: _____

APPROVAL SIGNATURE (PROJECT MANAGER): _____

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

21-01358 SHEET 18 OF 20

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-171	B	3	Plenum	Fiberglass Duct Insulation w/ sealant - 3rd Floor
2	2197-847-172	B	3		
3	2197-847-173	B	3		
4	2197-847-174	B	3		
5	2197-847-175	B	3		
6	2197-847-176	B	3	Plenum	Pipe Hanger Insulation - Soft white Fibrous Material
7	2197-847-177	B	3		
8	2197-847-178	B	1	Mech. Room	Fiberglass Pipe Insulation w/ Joint Sealant
9	2197-847-179	B	1		
10	2197-847-180	B	1		

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102 3617							
3618							
3619							
3620							
3621							
3622							
3623							
3624							
3625							
3626							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDIT = SURFACE DUST - TAPE SAMPLE
- SDIV = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/01/01 TIME COMPLETED: _____ DATE: 2/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00 PM INITIALS: TB
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 2/13/01

APPROVAL SIGNATURE (PROJECT MANAGER):

70 to Edward K. Noda

EDWARD K. NODA AND ASSOCIATES

21-01358 SHEET 19 OF 20

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-181	B	1	Mech. Room	Fiberglass Pipe Insulation - Hangers
2	2197-847-182	B	1		
3	2197-847-183	B	1		
4	2197-847-184	B	1		
5	2197-847-185	B	1		
6	2197-847-186	B	1		
7	2197-847-187	B	2	298 RM	HOT WATER TANK INSULATION
8	2197-847-188	B	2	267 RM	12" X 12" Lt Tan w/ Brown Straks/mastic
9	2197-847-189	B	3	368 RM	12" X 12" Lt Tan w/ Brown Strach/mastic
10	2197-847-190	B	3	327 RM	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102 3627							
3628							
3629							
3630							
3631							
3632							
3633							
3634							
3635							
3636							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDT = SURFACE DUST - TAPE SAMPLE
- SDV = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKN01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chen, D. Tisdell, C. Arouh
 SIGNATURE: _____
 DATE: 2/17/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FEDEX DATE: 2/17/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00 PM INITIALS: TB
 ANALYZED BY: _____
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

To be returned later

EDWARD K. NODA AND ASSOCIATES

21-01358 SHEET 20 OF 20

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-191	B	3	310	12" x 12" Lt Tan w/ Brown streaks/mastic
2	2197-847-192	B	3	39	12" x 12" Olive stripes/mastic
3	2197-847-193	B			
4	2197-847-194	B			
5	2197-847-195	B			
6	2197-847-196	B			
7	2197-847-197	B			
8	2197-847-198	B			
9	2197-847-199	B			
10	2197-847-200	B			

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2102							
3637							
3638							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/IT = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chase / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arough
 SIGNATURE: _____
 DATE: 2/10/01 TIME COMPLETED: _____
 DELIVERED TO LAB BY: FED-EX DATE: 2/10/01

LAB NAME: NMI Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: 2/13/01 TIME: 2:00 PM INITIALS: TB
 ANALYZED BY: SR
 LAB Q.C. APPROVAL: _____
 DATE: 2/28/01

APPROVAL SIGNATURE (PROJECT MANAGER):

Analyzed 5/3
 EDWARD K. NODA AND ASSOCIATES
 56 Log-in received
 at 3/6

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

21-01888 SHEET 1 of 6

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-	B			
2	2197-847-	B			
3	2197-847-193	B	R	Roof	Composition Built-up Roofing Material- Type I - Maza Roof
4	2197-847-194	B			
5	2197-847-195	B			
6	2197-847-196	B			
7	2197-847-197	B			
8	2197-847-198	B			
9	2197-847-199	B	Y	Y	Y
10	2197-847-200	B	R	Roof	Y

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Tisdell, C. Arouh
 SIGNATURE: [Signature] DATE: 2/01/01 TIME COMPLETED: [Signature]
 DELIVERED TO LAB BY: FED-EX DATE: 2/10/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] INITIALS: [Signature]
 DATE: [Signature] TIME: [Signature]
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature] DATE: 3/22/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

2101888 SHEET 2 OF 6

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-201	B	Roof	Roof	2" Roof Vent Flashing
2	2197-847-202	B			↓
3	2197-847-203	B			4" - 6" Roof Vent Flashing
4	2197-847-204	B			↓
5	2197-847-205	B			↓
6	2197-847-206	B	L.R	Lower Roof	Composition Built-up Roofing Material - Type II - Lower Roof
7	2197-847-207	B			↓
8	2197-847-208	B			↓
9	2197-847-209	B			Composition Built up Roofing Material - Flashing - Lower Roof
10	2197-847-210	B			↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1855							
1256							
1257							
1258							
1259							
1260							
1261							
1262							
1263							
1264							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES B = BULK MATERIAL D = DEBRIS SAMPLE SDIT = SURFACE DUST - TAPE SAMPLE SDM = SURFACE DUST - VACUUM SAMPLE SDIG = SURFACE DUST - GRAB SAMPLE	ACCOUNTABILITY RECORD	
	REQUESTED COMPLETION DATE: 5-10 day turn around JOB NO.: 2197-01F BATCH NO. EKNA01360 CLIENT NAME: Will Chee / Corp of Engineers SAMPLER'S NAME: K. Thomas, W Harris, S Chun, D. Nisdel, C Arouh SIGNATURE: <i>[Signature]</i> DATE: 2/01/01 TIME COMPLETED: <i>[Signature]</i> DELIVERED TO LAB BY: FED-EX DATE: 2/1/01	LAB NAME: NVL Laboratories, Inc. ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103 RECEIVED BY: _____ DATE: _____ TIME: _____ INITIALS: _____ ANALYZED BY: <i>[Signature]</i> LAB Q.C. APPROVAL: <i>[Signature]</i> DATE: 3/26/01
APPROVAL SIGNATURE (PROJECT MANAGER): _____		

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

21-01888 SHEET 3 OF 6

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-211	B	L.R	Lower Roof	Composition Built-up Roofing Material - Flashing - Lower Roof
2	2197-847-212	B	Roof	Roof	Beige Paint w/ Black Asphaltic Undercoat
3	2197-847-213	B			↓
4	2197-847-214	B			Roof Hatch Flashing
5	2197-847-215	B			↓
6	2197-847-216	B			Flue Stack Flashing
7	2197-847-217	B			↓
8	2197-847-218	B			12" x 12" Vent Flashing
9	2197-847-219	B			↓
10	2197-847-220	B			Pipe Mount Flashing

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1 2103							
2 1265							
3 1266							
4 1267							
5 1268							
6 1269							
7 1270							
8 1271							
9 1272							
10 1273							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

ACCOUNTABILITY RECORD

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SDIT = SURFACE DUST - TAPE SAMPLE
 SDV = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO.: EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chun, D. Fredell, C. Arouh
 SIGNATURE: *[Signature]*
 DATE: 2/10/01 TIME COMPLETED: *[Signature]* DATE: 2/10/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: _____ TIME: _____ INITIALS: _____
 ANALYZED BY: *[Signature]*
 LAB Q.C. APPROVAL: *[Signature]* DATE: 3/12/01

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

21-01888

SHEET 5 OF 4

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-231	B			Cementitious Plaster - Building Exterior - 1st Floor
2	2197-847-232	B			
3	2197-847-233	B			Cementitious Plaster - Building Exterior - 2nd Floor
4	2197-847-234	B			
5	2197-847-235	B			Cementitious Plaster - Building Exterior - 3rd Floor
6	2197-847-236	B			
7	2197-847-237	B			Root Vent Patch Material - Black - Above 1st Fl. Restroom
8	2197-847-238	B			
9	2197-847-239	B			
10	2197-847-	B			

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1	1285						
2	1286						
3	1287						
4	1288						
5	1289						
6	1290						
7	1291						
8	92						
9	1293						
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SDT = SURFACE DUST - TAPE SAMPLE
 SDV = SURFACE DUST - VACUUM SAMPLE
 SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chum, D. Tisdell, C. Arooh
 SIGNATURE: *[Signature]*
 DATE: 2/01/01 TIME COMPLETED: *[Signature]* DATE: 2/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____ TIME: _____ INITIALS: _____
 ANALYZED BY: *[Signature]*
 LAB Q.C. APPROVAL: _____ DATE: _____

APPROVAL SIGNATURE (PROJECT MANAGER):

EDWARD K. NODA AND ASSOCIATES

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

21-01888 SHEET 2 OF 6

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 847, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-847-178	B	1	Mech Room	Fiberglass Pipe Insulation w/ Joint Sealant
2	2197-847-179	B	1		
3	2197-847-180	B	1		
4	2197-847-181	B	1		
5	2197-847-182	B	1		Fiberglass Pipe Insulation - Hangers / Saddles
6	2197-847-183	B	1		
7	2197-847-184	B	1		Hot Water Tank Insulation - White
8	2197-847-185	B	1		
9	2197-847-186	B	1		
10	2197-847-	B			

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
2103							
1294							
1295							
1296							
1297							
1298							
1299							
1300							
1301							
1302							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

ACCOUNTABILITY RECORD

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/T = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

REQUESTED COMPLETION DATE: 5-10 day turn around
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Cree / Corp of Engineers
 SAMPLER'S NAME: K. Thomas, W. Harris, S. Chiu, D. Tisdell, C. Arouh
 SIGNATURE: *[Signature]*
 DATE: 2/10/01 TIME COMPLETED: *[Signature]*
 DELIVERED TO LAB BY: FED-EX DATE: 2/1/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____
 DATE: _____ TIME: _____ INITIALS: _____
 ANALYZED BY: *[Signature]*
 LAB Q.C. APPROVAL: *[Signature]*
 DATE: 3/22/01

APPROVAL SIGNATURE (PROJECT MANAGER):

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023446 Client Sample #: 2197-847-001

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023447 Client Sample #: 2197-847-002

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023448 Client Sample #: 2197-847-003

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

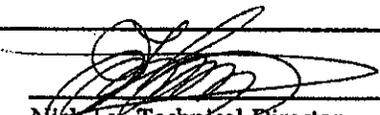
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21023449 Client Sample #: 2197-847-004

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:
 Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:
 Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE: PERCENT
 *None Detected ND

Lab ID #: 21023450 Client Sample #: 2197-847-005

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:
 LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21023451 Client Sample #: 2197-847-006

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:
 Cellulose 25%, Glass fibers 5%

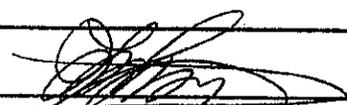
NON-FIBROUS MATERIALS:
 Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56***None Detected****ND**

Lab ID #: 21023452 Client Sample #: 2197-847-007

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: White chalky material with paper and paint**OTHER FIBROUS MATERIALS:**
Cellulose 25%, Glass fibers 5%**NON-FIBROUS MATERIALS:**
Binder & filler, Gypsum/binder, Paint**ASBESTOS TYPE:**
None Detected*PERCENT**
ND

Lab ID #: 21023453 Client Sample #: 2197-847-008

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: LAYER 1: Yellow mastic, LAYER 2: White chalky material with paper and paint**OTHER FIBROUS MATERIALS:**
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 6%**NON-FIBROUS MATERIALS:**
LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Gypsum/binder**ASBESTOS TYPE:**
LAYER 1: *None Detected
LAYER 2: *None Detected**PERCENT**
ND
ND

Lab ID #: 21023454 Client Sample #: 2197-847-009

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: LAYER 1: Yellow mastic, LAYER 2: White powdery material with paint, LAYER 3: White chalky material with paper**OTHER FIBROUS MATERIALS:**
LAYER 1: Cellulose 3%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%, Glass fibers 5%**NON-FIBROUS MATERIALS:**
LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Paint
LAYER 3: Binder & filler, Gypsum/binder**ASBESTOS TYPE:****PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01355.00

Client Project #: 2197-01F

Number of samples: 56

Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21023455 Client Sample #: 2197-847-010

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023456 Client Sample #: 2197-847-011

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: White powdery material with paint, LAYER 3: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder

LAYER 2: Binder & filler, Paint

LAYER 3: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

LAYER 3: *None Detected

PERCENT

ND

ND

ND

(Sample results are continued on the next page.)

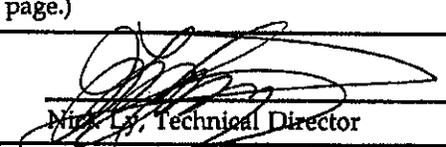
Sampled by: Client

Analyzed by: Wei Long Tai

Date: 02/27/2001

Reviewed by: Nick Ly

Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01355.00

Client Project #: 2197-01F

Number of samples: 56

Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

Lab ID #: 21023457 Client Sample #: 2197-847-012

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 7%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Gypsum/binder**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023458 Client Sample #: 2197-847-013

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White mastic, LAYER 2: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 25%, Glass fibers 7%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Gypsum/binder**ASBESTOS TYPE: PERCENT**LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

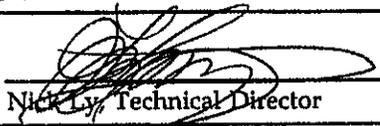
Lab ID #: 21023459 Client Sample #: 2197-847-014

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White mastic, LAYER 2: White powdery material with paint, LAYER 3: White chalky material with paper

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%
LAYER 3: Cellulose 25%, Glass fibers 7%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Binder & filler, Paint
LAYER 3: Binder & filler, Gypsum/binder**ASBESTOS TYPE: PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

LAYER 1:	*None Detected	ND
LAYER 2:	*None Detected	ND
LAYER 3:	*None Detected	ND

Lab ID #: 21023460 Client Sample #: 2197-847-015

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: White chalky material with paper**OTHER FIBROUS MATERIALS:**

Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023461 Client Sample #: 2197-847-016

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White mastic, LAYER 2: White powdery material with paint, LAYER 3: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 3%

LAYER 3: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder

LAYER 2: Binder & filler, Paint

LAYER 3: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

LAYER 3: *None Detected

PERCENT

ND

ND

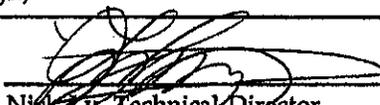
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023462 Client Sample #: 2197-847-017

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21023463 Client Sample #: 2197-847-018

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

Lab ID #: 21023464 Client Sample #: 2197-847-019

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

(Sample results are continued on the next page.)

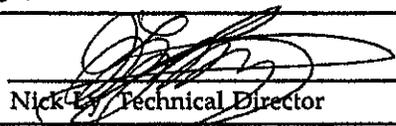
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023465 Client Sample #: 2197-847-020

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray/white sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Mica

PERCENT

ND

Lab ID #: 21023466 Client Sample #: 2197-847-021

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray/white sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023467 Client Sample #: 2197-847-022

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray/white sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Mica

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All Bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814**NVL Batch Number: 21-01355.00****Client Project #: 2197-01F****Number of samples: 56**Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, Hawaii**Lab ID #: 21023468 Client Sample #: 2197-847-023****Sample Location:** Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray/white sandy brittle material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint, Mica

PERCENT

ND

Lab ID #: 21023469 Client Sample #: 2197-847-024**Sample Location:** Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray/white sandy brittle material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023470 Client Sample #: 2197-847-025**Sample Location:** Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray/white sandy brittle material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

(Sample results are continued on the next page.)

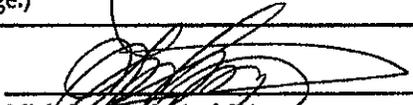
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023471 Client Sample #: 2197-847-026

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21023472 Client Sample #: 2197-847-027

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21023473 Client Sample #: 2197-847-028

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

(Sample results are continued on the next page.)

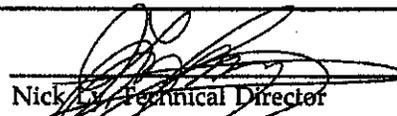
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023474 Client Sample #: 2197-847-029

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21023475 Client Sample #: 2197-847-030

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21023476 Client Sample #: 2197-847-031

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: White powdery material with paint, LAYER 2: Gray sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 3%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Granules

PERCENT

ND

ND

(Sample results are continued on the next page.)

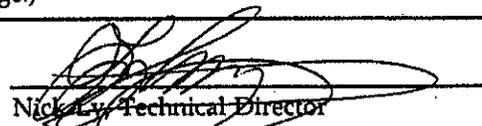
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023477 Client Sample #: 2197-847-032

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023478 Client Sample #: 2197-847-033

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023479 Client Sample #: 2197-847-034

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

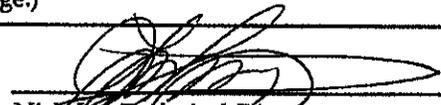
ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

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 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023480 Client Sample #: 2197-847-035

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023481 Client Sample #: 2197-847-036

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

PERCENT

ND

Lab ID #: 21023482 Client Sample #: 2197-847-037

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

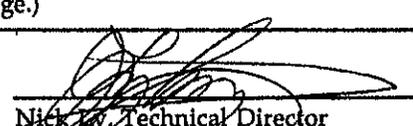
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21023483 Client Sample #: 2197-847-038

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: White soft material, LAYER 2: Tan chalky material with paper and paint

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023484 Client Sample #: 2197-847-039

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023485 Client Sample #: 2197-847-040

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 80%

NON-FIBROUS MATERIALS:

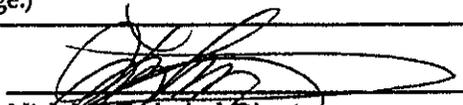
Binder & filler

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023486 Client Sample #: 2197-847-041

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Tan fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 21023487 Client Sample #: 2197-847-042

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Tan fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 21023488 Client Sample #: 2197-847-043

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Tan fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 80%

ASBESTOS TYPE:

*None Detected

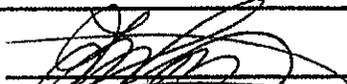
NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023489 Client Sample #: 2197-847-044

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Tan fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 21023490 Client Sample #: 2197-847-045

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Tan fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 80%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler

PERCENT

ND

Lab ID #: 21023491 Client Sample #: 2197-847-046

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

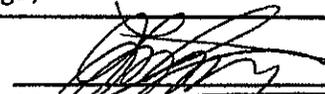
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023492 Client Sample #: 2197-847-047

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023493 Client Sample #: 2197-847-048

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023494 Client Sample #: 2197-847-049

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

(Sample results are continued on the next page.)

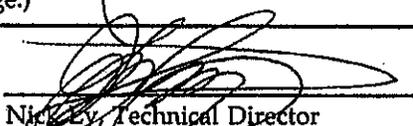
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

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Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023495 Client Sample #: 2197-847-050

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023496 Client Sample #: 2197-847-051

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023497 Client Sample #: 2197-847-052

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

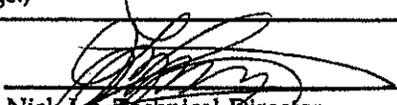
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick Ly

Date: 02/27/2001
Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01355.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21023498 Client Sample #: 2197-847-053

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023499 Client Sample #: 2197-847-054

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

Lab ID #: 21023500 Client Sample #: 2197-847-055

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray fibrous material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 60%, Glass fibers 10%

ASBESTOS TYPE:

*None Detected

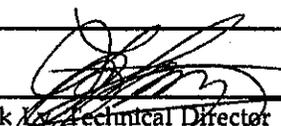
NON-FIBROUS MATERIALS:

Binder & filler, Paint

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01355.00

Client Project #: 2197-01F

Number of samples: 56

Attn.: Mr. William Harris

Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

Lab ID #: 21023501 Client Sample #: 2197-847-056

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: Gray fibrous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and aculty of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
 Client Project #: 2197-01F
 Number of samples: 44

Lab ID #: 21023503 Client Sample #: 2197-847-057

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 15%

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite, Glass beads

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023504 Client Sample #: 2197-847-058

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 15%

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite, Glass beads

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023505 Client Sample #: 2197-847-059

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 15%

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite, Glass beads

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates

Address: 615 Piikoi Street, Suite 300

Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

Lab ID #: 21023506 Client Sample #: 2197-847-060

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 15%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite, Glass beads

PERCENT

ND

Lab ID #: 21023507 Client Sample #: 2197-847-061

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 45%, Glass fibers 15%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite, Glass beads

PERCENT

ND

Lab ID #: 21023508 Client Sample #: 2197-847-062

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite

PERCENT

ND

(Sample results are continued on the next page.)

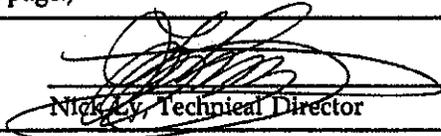
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01356.00
Client Project #: 2197-01F
Number of samples: 44

Lab ID #: 21023509 Client Sample #: 2197-847-063

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Grey fibrous and porous material with paint**OTHER FIBROUS MATERIALS:**
Cellulose 65%, Glass fibers 5%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint, Perlite
PERCENT
ND

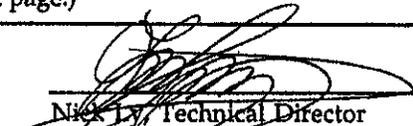
Lab ID #: 21023510 Client Sample #: 2197-847-064

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Grey fibrous and porous material with paint**OTHER FIBROUS MATERIALS:**
Cellulose 65%, Glass fibers 3%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint, Perlite
PERCENT
ND

Lab ID #: 21023511 Client Sample #: 2197-847-065

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Grey fibrous and porous material with paint**OTHER FIBROUS MATERIALS:**
Cellulose 65%, Glass fibers 3%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Calcareous matrix, Paint, Perlite
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/26/2001
Date: 02/26/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**NVLAP**
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

Lab ID #: 21023512 Client Sample #: 2197-847-066

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite

PERCENT

ND

Lab ID #: 21023513 Client Sample #: 2197-847-067

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 65%, Glass fibers 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix, Paint, Perlite

PERCENT

ND

Lab ID #: 21023514 Client Sample #: 2197-847-068

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Black rubbery material LAYER 2: White mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 2%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

PERCENT

ND

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

Lab ID #: 21023515 Client Sample #: 2197-847-069

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Black rubbery material LAYER 2: White/brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023516 Client Sample #: 2197-847-070

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Black rubbery material LAYER 2: White mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Rubber/binder
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023517 Client Sample #: 2197-847-071

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Black rubbery material with white mastic

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
Client Project #: 2197-01F
Number of samples: 44

Lab ID #: 21023518 Client Sample #: 2197-847-072

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Black rubbery material with white/brown mastic

OTHER FIBROUS MATERIALS:
Cellulose 2%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Mastic/binder
PERCENT
ND

Lab ID #: 21023519 Client Sample #: 2197-847-073

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Brown rubbery material with yellow mastic

OTHER FIBROUS MATERIALS:
Cellulose 3%

ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Mastic/binder
PERCENT
ND

Lab ID #: 21023520 Client Sample #: 2197-847-074

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Brown rubbery material with white mastic

OTHER FIBROUS MATERIALS:
Cellulose 3%

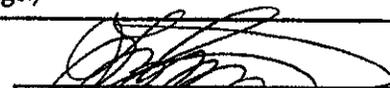
ASBESTOS TYPE:
*None Detected

NON-FIBROUS MATERIALS:
Rubber/binder, Mastic/binder
PERCENT
ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/26/2001
Date: 02/26/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
 Client Project #: 2197-01F
 Number of samples: 44

Lab ID #: 21023521 Client Sample #: 2197-847-075

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Brown rubbery material with white mastic

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

PERCENT

ND

Lab ID #: 21023522 Client Sample #: 2197-847-076

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Brown rubbery material with white mastic

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

PERCENT

ND

Lab ID #: 21023523 Client Sample #: 2197-847-077

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown rubbery material with paint LAYER 2: Brown mastic LAYER 3: Paint with powdery material and fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 2%

LAYER 3: Cellulose 25%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

LAYER 3: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder, Paint

LAYER 2: Mastic/binder

LAYER 3: Calcareous matrix, Paint, Fine particles

PERCENT

ND

ND

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

Lab ID #: 21023524 Client Sample #: 2197-847-078

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Beige rubbery material with mastic

OTHER FIBROUS MATERIALS:

*None Detected

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023525 Client Sample #: 2197-847-079

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige rubbery material with mastic LAYER 2: Tan/black paint

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Calcareous matrix, Paint

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

Lab ID #: 21023526 Client Sample #: 2197-847-080

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige rubbery material with mastic LAYER 2: Tan/black paint

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Calcareous matrix, Paint

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

(Sample results are continued on the next page.)

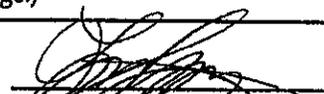
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01356.00
Client Project #: 2197-01F
Number of samples: 44Lab ID #: 21023527 Client Sample #: 2197-847-081
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Brown brittle mastic**OTHER FIBROUS MATERIALS:**

*None Detected

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Mastic/binder

PERCENT

ND

Lab ID #: 21023528 Client Sample #: 2197-847-082
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Brown brittle mastic with black asphaltic material**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Mastic/binder, Asphalt/binder

PERCENT

3%

Sample comments: Asbestos found in asphaltic material

Lab ID #: 21023529 Client Sample #: 2197-847-083
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Brown brittle mastic with fibrous material**OTHER FIBROUS MATERIALS:**

Cellulose 25%

ASBESTOS TYPE:

*None Detected

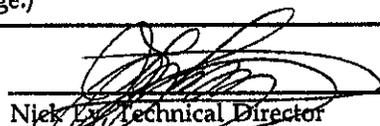
NON-FIBROUS MATERIALS:

Mastic/binder, Glass beads

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/26/2001
Date: 02/26/2001
Nick Ly, Technical Director

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
 Client Project #: 2197-01F
 Number of samples: 44

Lab ID #: 21023530 Client Sample #: 2197-847-084

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material with woven fiber LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Glass fibers 10%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 21023531 Client Sample #: 2197-847-085

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material with woven fiber LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Glass fibers 10%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 21023532 Client Sample #: 2197-847-086

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F
Number of samples: 44

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 21023533 Client Sample #: 2197-847-087

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 21023534 Client Sample #: 2197-847-088

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Green tile with trace black asphaltic mastic**OTHER FIBROUS MATERIALS:**

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Asphalt/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023535 Client Sample #: 2197-847-089

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

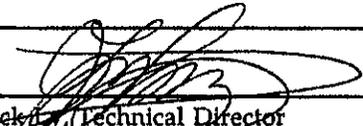
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001



 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/115 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 21023536 Client Sample #: 2197-847-090

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 21023537 Client Sample #: 2197-847-091

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Blue tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
 Client Project #: 2197-01F
 Number of samples: 44

Lab ID #: 21023538 Client Sample #: 2197-847-092

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Blue tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023539 Client Sample #: 2197-847-093

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Blue tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder, Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

Lab ID #: 21023540 Client Sample #: 2197-847-094

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/26/2001
 Date: 02/26/2001


 Nick Ly, Technical Director

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00

Client Project #: 2197-01F

Number of samples: 44

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023541 Client Sample #: 2197-847-095

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023542 Client Sample #: 2197-847-096

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder, Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

(Sample results are continued on the next page.)

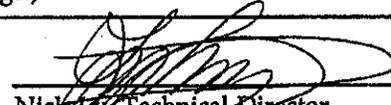
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

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#102063

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 Address: 615 Piikoi Street, Suite 300
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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
 Client Project #: 2197-01F
 Number of samples: 44

Lab ID #: 21023543 Client Sample #: 2197-847-097

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder, Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 21023544 Client Sample #: 2197-847-098

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023545 Client Sample #: 2197-847-099

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

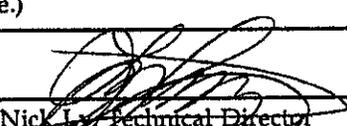
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/26/2001

Date: 02/26/2001


 Nick Ly, Technical Director

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
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Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01356.00
Client Project #: 2197-01F
Number of samples: 44

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023546 Client Sample #: 2197-847-100

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
LAYER 2: Cellulose 2%

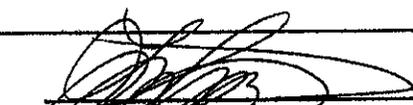
NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/26/2001
Date: 02/26/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023547 Client Sample #: 2197-847-101

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Brown mastic with paint

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Paint, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023548 Client Sample #: 2197-847-102

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023549 Client Sample #: 2197-847-103

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

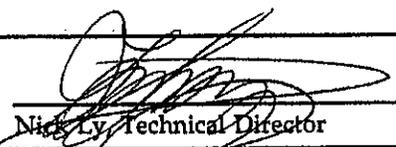
NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063**Bulk Asbestos Fiber Analysis**

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21023550 Client Sample #: 2197-847-104
 Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Beige tile with trace brown mastic

OTHER FIBROUS MATERIALS:
 Cellulose 2%

NON-FIBROUS MATERIALS:
 Calcareous matrix, Mastic/binder

ASBESTOS TYPE: PERCENT
 *None Detected ND

Lab ID #: 21023551 Client Sample #: 2197-847-105
 Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Grey tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:
 LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
 LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: Chrysotile <1%

Lab ID #: 21023552 Client Sample #: 2197-847-106
 Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Grey tile LAYER 2: Brown mastic with trace black asphaltic mastic

OTHER FIBROUS MATERIALS:
 LAYER 1: *None Detected
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:
 LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00

Client Project #: 2197-01F

Number of samples: 60

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023553 Client Sample #: 2197-847-107

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Grey tile

OTHER FIBROUS MATERIALS:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21023554 Client Sample #: 2197-847-108

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Tan tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Asphalt/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: Chrysotile

PERCENT

ND

2%

Lab ID #: 21023555 Client Sample #: 2197-847-109

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Tan tile with black asphaltic mastic

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Asphalt/binder

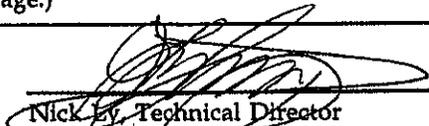
ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Chrysotile <1%

Sample comments: Asbestos found in mastic

Lab ID #: 21023556 Client Sample #: 2197-847-110

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Tan tile

OTHER FIBROUS MATERIALS:

*None Detected

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix

PERCENT

ND

Lab ID #: 21023557 Client Sample #: 2197-847-111

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Green tile with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix

PERCENT

ND

Lab ID #: 21023558 Client Sample #: 2197-847-112

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Green tile with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Calcareous matrix

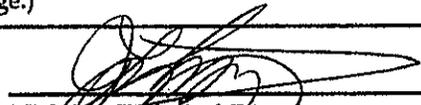
PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023559 Client Sample #: 2197-847-113

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 21023560 Client Sample #: 2197-847-114

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023561 Client Sample #: 2197-847-115

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: LAYER 1: Beige tile LAYER 2: Brown mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01357.00
Client Project #: 2197-01F
Number of samples: 60LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023562 Client Sample #: 2197-847-116

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Black tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder, Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%

Lab ID #: 21023563 Client Sample #: 2197-847-117

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Brown tile with trace mastic

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix, Mastic/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023564 Client Sample #: 2197-847-118

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Brown tile with trace mastic

OTHER FIBROUS MATERIALS:

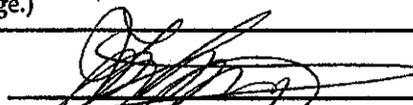
Cellulose 3%

NON-FIBROUS MATERIALS:

Calcareous matrix, Mastic/binder

ASBESTOS TYPE:	PERCENT
----------------	---------

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/28/2001
Date: 02/28/2001

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

None Detected*ND**

Lab ID #: 21023565 Client Sample #: 2197-847-119

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil, mastic and white fiber LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%, Glass fibers 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Mastic/binder, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21023566 Client Sample #: 2197-847-120

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil, mastic and white fiber LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%, Glass fibers 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Mastic/binder, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21023567 Client Sample #: 2197-847-121

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil, mastic and white fiber LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%, Glass fibers 15%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Mastic/binder, Fine particles
 LAYER 2: Fine particles

(Sample results are continued on the next page.)

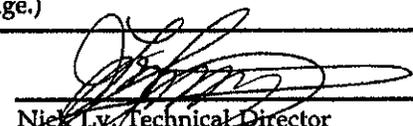
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001


 Nick Ly, Technical Director

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01357.00

Client Project #: 2197-01F

Number of samples: 60

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023568 Client Sample #: 2197-847-122

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%, Glass fibers 15%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023569 Client Sample #: 2197-847-123

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material LAYER 2: White fibrous material with silver metal foil LAYER 3: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 45%

LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Metal foil, Fine particles

LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	3%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

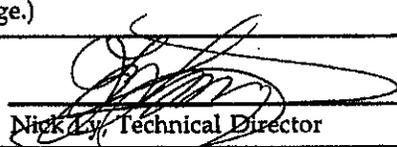
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023570 Client Sample #: 2197-847-124

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material LAYER 2: White fibrous material with silver metal foil and mastic LAYER 3: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 45%
 LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix
 LAYER 2: Metal foil, Fine particles
 LAYER 3: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21023571 Client Sample #: 2197-847-125

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023572 Client Sample #: 2197-847-126

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Sample not recieved

OTHER FIBROUS MATERIALS:

Sample not recieved

NON-FIBROUS MATERIALS:

Sample not recieved

(Sample results are continued on the next page.)

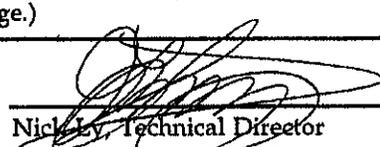
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

ASBESTOS TYPE:	PERCENT
Sample not recieved	ND

Lab ID #: 21023573 Client Sample #: 2197-847-127

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil, mastic and paint LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles, Paint
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023574 Client Sample #: 2197-847-128

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil, mastic, brown flaky material and grey soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles, Paint,
 Vermiculite
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01357.00

Client Project #: 2197-01F

Number of samples: 60

Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Lab ID #: 21023575 Client Sample #: 2197-847-129

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White fibrous material with silver metal foil LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%, Glass fibers 15%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21023576 Client Sample #: 2197-847-130

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material LAYER 2: White fibrous material with silver metal foil and mastic LAYER 3: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 45%

LAYER 3: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Metal foil, Fine particles

LAYER 3: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: Chrysotile 2%

LAYER 2: *None Detected ND

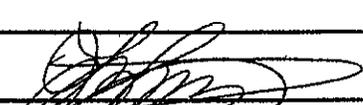
LAYER 3: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001



Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023577 Client Sample #: 2197-847-131

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Calcareous matrix, Metal foil, Mastic/binder
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023578 Client Sample #: 2197-847-132

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

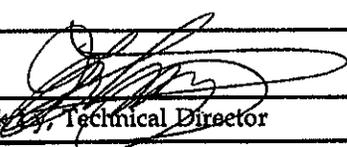
LAYER 1: Fine particles, Calcareous matrix, Metal foil, Mastic/binder
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023579 Client Sample #: 2197-847-133

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Calcareous matrix, Metal foil, Mastic/binder
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023580 Client Sample #: 2197-847-134

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

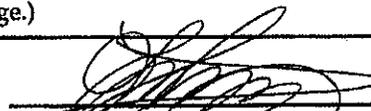
LAYER 1: Fine particles, Calcareous matrix, Metal foil, Mastic/binder
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
Client Project #: 2197-01F
Number of samples: 60

Lab ID #: 21023581 Client Sample #: 2197-847-135

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Calcareous matrix, Metal foil, Mastic/binder
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023582 Client Sample #: 2197-847-136

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

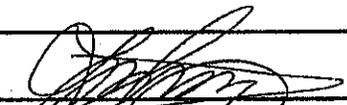
LAYER 1: Calcareous matrix, Fine particles, Mastic/binder, Metal foil
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/28/2001
Date: 02/28/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023583 Client Sample #: 2197-847-137

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023584 Client Sample #: 2197-847-138

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

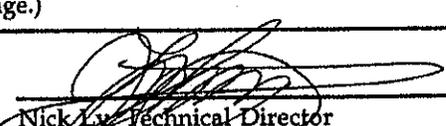
LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023585 Client Sample #: 2197-847-139

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2:
Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023586 Client Sample #: 2197-847-140

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2:
Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

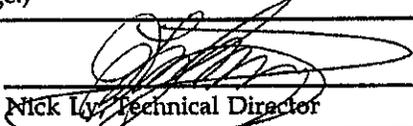
LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

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 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023587 Client Sample #: 2197-847-141

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023588 Client Sample #: 2197-847-142

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

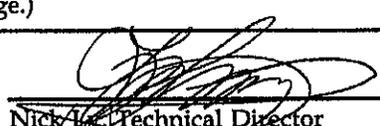
LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023589 Client Sample #: 2197-847-143

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix, Fine particles,
 Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023590 Client Sample #: 2197-847-144

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023591 Client Sample #: 2197-847-145

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

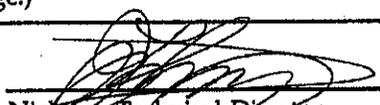
LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023592 Client Sample #: 2197-847-146

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber and mastic LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023593 Client Sample #: 2197-847-147

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023594 Client Sample #: 2197-847-148

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023595 Client Sample #: 2197-847-149

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023596 Client Sample #: 2197-847-150

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01357.00

Client Project #: 2197-01F

Number of samples: 60

Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023597 Client Sample #: 2197-847-151

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and trace white soft material
LAYER 2: Brown fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 65%**NON-FIBROUS MATERIALS:**LAYER 1: Fine particles, Mastic/binder, Metal foil
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	<1%
LAYER 2: *None Detected	ND

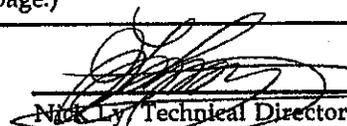
Lab ID #: 21023598 Client Sample #: 2197-847-152

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2:
Brown fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 45%
LAYER 2: Glass fibers 65%**NON-FIBROUS MATERIALS:**LAYER 1: Fine particles, Mastic/binder, Metal foil
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/28/2001
Date: 02/28/2001


Nick Ly Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023599 Client Sample #: 2197-847-153

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023600 Client Sample #: 2197-847-154

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Brown fibrous material with silver metal foil, white woven fiber, mastic and white soft material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 45%
 LAYER 2: Glass fibers 65%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Mastic/binder, Metal foil
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: Chrysotile	2%
LAYER 2: *None Detected	ND

Lab ID #: 21023601 Client Sample #: 2197-847-155

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: Black rubbery material with white woven fiber

OTHER FIBROUS MATERIALS:

Glass fibers 35%

NON-FIBROUS MATERIALS:

Rubber/binder, Fine particles

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

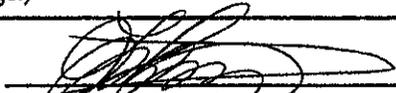
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/28/2001

Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023602 Client Sample #: 2197-847-156

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 35%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Paint, Perlite, Calcareous matrix

PERCENT

ND

Lab ID #: 21023603 Client Sample #: 2197-847-157

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 35%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Paint, Perlite, Calcareous matrix

PERCENT

ND

Lab ID #: 21023604 Client Sample #: 2197-847-158

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 35%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Paint, Perlite, Calcareous matrix

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01357.00
 Client Project #: 2197-01F
 Number of samples: 60

Lab ID #: 21023605 Client Sample #: 2197-847-159

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Grey fibrous and porous material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 35%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Paint, Perlite, Calcareous matrix

PERCENT

ND

Lab ID #: 21023606 Client Sample #: 2197-847-160

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
 Description: Brown fibrous material

OTHER FIBROUS MATERIALS:

Cellulose 65%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

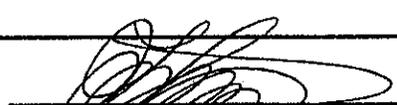
Fine particles

PERCENT

ND

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/28/2001
 Date: 02/28/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01358.00
 Client Project #: 2197-01F
 Number of samples: 23

Lab ID #: 21023607 Client Sample #: 2197-847-161

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023608 Client Sample #: 2197-847-162

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023609 Client Sample #: 2197-847-163

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

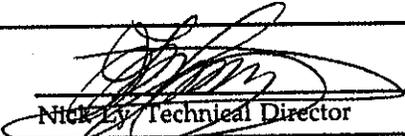
NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda and Associates
Address: 615 Pilkoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01358.00
Client Project #: 2197-01F
Number of samples: 23LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023610 Client Sample #: 2197-847-164

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 25%, Glass fibers 25%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder, Metal foil, Fine particles
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023611 Client Sample #: 2197-847-165

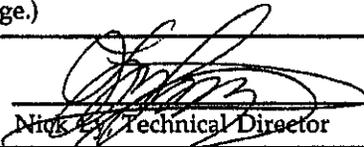
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with adhesive LAYER 2: Pink fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Adhesive/binder
LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001

 Nick Ly, Technical Director

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#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01358.00
 Client Project #: 2197-01F
 Number of samples: 23

Lab ID #: 21023612 Client Sample #: 2197-847-166

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023613 Client Sample #: 2197-847-167

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023614 Client Sample #: 2197-847-168

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%
 LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

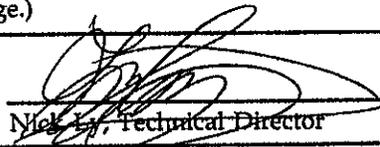
LAYER 1: Mastic/binder, Metal foil, Fine particles
 LAYER 2: Fine particles

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01358.00

Client Project #: 2197-01F

Number of samples: 23

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023615 Client Sample #: 2197-847-169

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21023616 Client Sample #: 2197-847-170

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

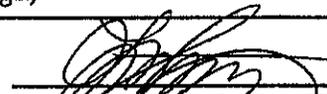
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01358.00

Client Project #: 2197-01F

Number of samples: 23

Attn.: Mr. William Harris

Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Lab ID #: 21023617 Client Sample #: 2197-847-171

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21023618 Client Sample #: 2197-847-172

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21023619 Client Sample #: 2197-847-173

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 25%, Glass fibers 25%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder, Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

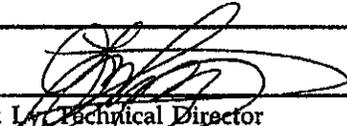
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01358.00
Client Project #: 2197-01F
Number of samples: 23

LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023620 Client Sample #: 2197-847-174

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 25%, Glass fibers 25%
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:
LAYER 1: Mastic/binder, Metal foil, Fine particles
LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023621 Client Sample #: 2197-847-175

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Silver metal foil with white woven fiber, brown fibrous material and mastic LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:
LAYER 1: Cellulose 25%, Glass fibers 25%
LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:
LAYER 1: Mastic/binder, Metal foil, Fine particles
LAYER 2: Fine particles

ASBESTOS TYPE: PERCENT
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023622 Client Sample #: 2197-847-176

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: White fibrous powdery material with silver metal foil

OTHER FIBROUS MATERIALS:
Synthetic fibers 35%

NON-FIBROUS MATERIALS:
Calcareous matrix, Metal foil

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 02/27/2001
Date: 02/27/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01358.00
Client Project #: 2197-01F
Number of samples: 23

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023623 Client Sample #: 2197-847-177
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: White fibrous powdery material with silver metal foilOTHER FIBROUS MATERIALS:
Synthetic fibers 35%NON-FIBROUS MATERIALS:
Calcareous matrix, Metal foil

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023633 Client Sample #: 2197-847-187
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Beige tile LAYER 2: Black asphaltic masticOTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 2%NON-FIBROUS MATERIALS:
LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023634 Client Sample #: 2197-847-188
Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Beige tile LAYER 2: Black asphaltic masticOTHER FIBROUS MATERIALS:
LAYER 1: *None Detected
LAYER 2: Cellulose 2%NON-FIBROUS MATERIALS:
LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

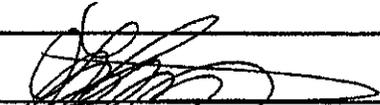
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 02/27/2001

Date: 02/27/2001



 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J - Bldg - 847, Schofield Barracks, HawaiiNVL Batch Number: 21-01358.00
Client Project #: 2197-01F
Number of samples: 23LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21023635 Client Sample #: 2197-847-189

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: LAYER 1: Beige tile LAYER 2: Black asphaltic mastic**OTHER FIBROUS MATERIALS:**LAYER 1: *None Detected
LAYER 2: Cellulose 2%**NON-FIBROUS MATERIALS:**LAYER 1: Calcareous matrix
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21023636 Client Sample #: 2197-847-190

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Beige tile with trace mastic**OTHER FIBROUS MATERIALS:**

Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Mastic/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21023637 Client Sample #: 2197-847-191

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii
Description: Beige tile with trace mastic**OTHER FIBROUS MATERIALS:**

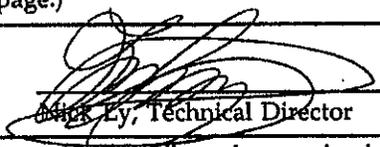
Cellulose 2%

NON-FIBROUS MATERIALS:

Calcareous matrix, Mastic/binder

ASBESTOS TYPE:	PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick LyDate: 02/27/2001
Date: 02/27/2001

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All Bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01358.00
 Client Project #: 2197-01F
 Number of samples: 23

None Detected*ND**

Lab ID #: 21023638 Client Sample #: 2197-847-192

Sample Location: Quad J - Bldg - 847, Schofield Barracks, Hawaii

Description: LAYER 1: Green tile LAYER 2: Mixture of brown mastic and black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

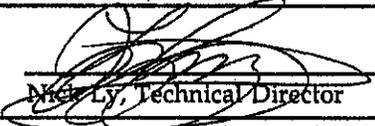
LAYER 1: Calcareous matrix
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	2%

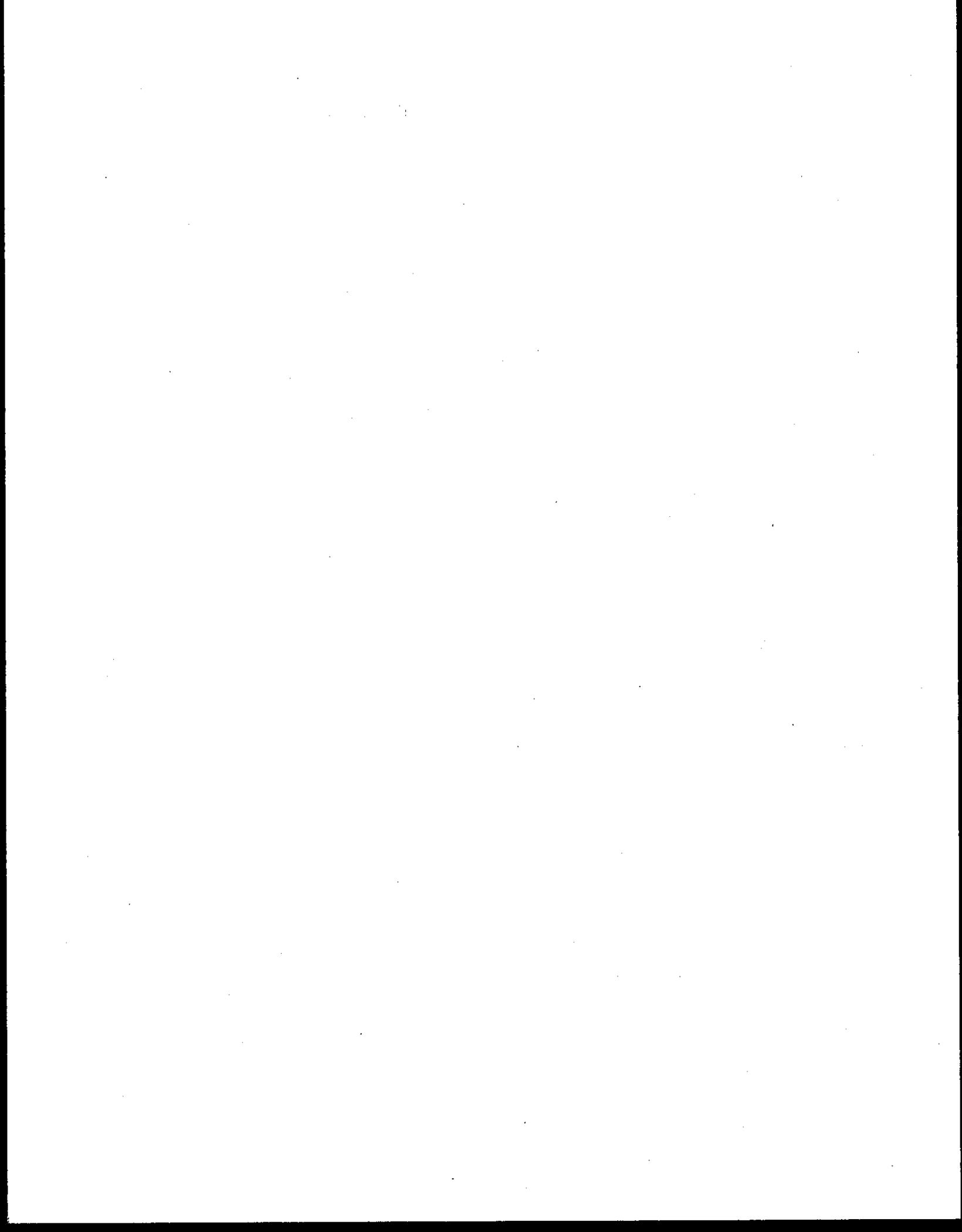
Sample comments: Asbestos found in asphaltic mastic

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 02/27/2001
 Date: 02/27/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



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#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031247 Client Sample #: 2197-847-193

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 5%, Glass fibers 27%
 LAYER 2: Cellulose 1%

NON-FIBROUS MATERIALS:
 LAYER 1: Asphalt/binder, Sand/binder
 LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031248 Client Sample #: 2197-847-194

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 5%, Glass fibers 27%
 LAYER 2: Cellulose 1%

NON-FIBROUS MATERIALS:
 LAYER 1: Asphalt/binder, Sand/binder
 LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031249 Client Sample #: 2197-847-195

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

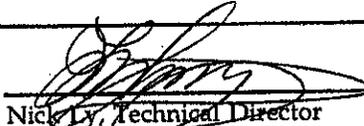
OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 5%, Glass fibers 27%
 LAYER 2: Cellulose 1%

NON-FIBROUS MATERIALS:
 LAYER 1: Asphalt/binder, Sand/binder
 LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01888.00
Client Project #: 2197-01F
Number of samples: 56LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

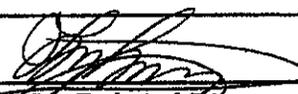
Lab ID #: 21031250 Client Sample #: 2197-847-196

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material**OTHER FIBROUS MATERIALS:**
LAYER 1: Cellulose 5%, Glass fibers 27%
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**
LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler, Synthetic foam**ASBESTOS TYPE: PERCENT**
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

Lab ID #: 21031251 Client Sample #: 2197-847-197

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material**OTHER FIBROUS MATERIALS:**
LAYER 1: Cellulose 5%, Glass fibers 27%
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**
LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler, Synthetic foam**ASBESTOS TYPE: PERCENT**
LAYER 1: *None Detected ND
LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 03/15/2001
Date: 03/15/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01888.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21031252 Client Sample #: 2197-847-198

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 27%
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031253 Client Sample #: 2197-847-199

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 27%
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031254 Client Sample #: 2197-847-200

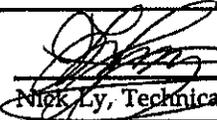
Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic built-up material, LAYER 2: Black soft material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 27%
LAYER 2: Cellulose 1%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler, Synthetic foam

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 03/15/2001
Date: 03/15/2001

 Nick Ly, Technical Director

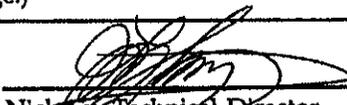
Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01888.00
Client Project #: 2197-01F
Number of samples: 56LAYER 1: *None Detected ND
LAYER 2: *None Detected NDLab ID #: 21031255 Client Sample #: 2197-847-201
Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Black asphaltic material**OTHER FIBROUS MATERIALS:**
Cellulose 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Asphalt/binder**PERCENT**
NDLab ID #: 21031256 Client Sample #: 2197-847-202
Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Black asphaltic material**OTHER FIBROUS MATERIALS:**
Cellulose 20%**ASBESTOS TYPE:**
*None Detected**NON-FIBROUS MATERIALS:**
Asphalt/binder**PERCENT**
NDLab ID #: 21031257 Client Sample #: 2197-847-203
Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Black asphaltic material**OTHER FIBROUS MATERIALS:**
Cellulose 15%**ASBESTOS TYPE:**
Chrysotile**NON-FIBROUS MATERIALS:**
Asphalt/binder**PERCENT**
4%

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 03/15/2001
Date: 03/15/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031258 Client Sample #: 2197-847-204

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Sample not analyzed.

OTHER FIBROUS MATERIALS:
 Sample not analyzed.

ASBESTOS TYPE:
 Sample not analyzed.

NON-FIBROUS MATERIALS:
 Sample not analyzed.

PERCENT
 ND

Lab ID #: 21031259 Client Sample #: 2197-847-205

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Sample not analyzed.

OTHER FIBROUS MATERIALS:
 Sample not analyzed.

ASBESTOS TYPE:
 Sample not analyzed.

NON-FIBROUS MATERIALS:
 Sample not analyzed.

PERCENT
 ND

Lab ID #: 21031260 Client Sample #: 2197-847-206

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic built-up material

OTHER FIBROUS MATERIALS:
 Cellulose 7%, Glass fibers 25%

ASBESTOS TYPE:
 *None Detected

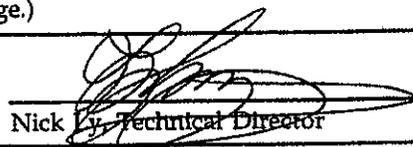
NON-FIBROUS MATERIALS:
 Asphalt/binder, Sand/binder

PERCENT
 ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031261 Client Sample #: 2197-847-207

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic built-up material

OTHER FIBROUS MATERIALS:

Cellulose 7%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Sand/binder

PERCENT

ND

Lab ID #: 21031262 Client Sample #: 2197-847-208

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic built-up material

OTHER FIBROUS MATERIALS:

Cellulose 7%, Glass fibers 25%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Sand/binder

PERCENT

ND

Lab ID #: 21031263 Client Sample #: 2197-847-209

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Tan fibrous material, LAYER 2: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 70%

LAYER 2: Cellulose 4%, Glass fibers 25%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler

LAYER 2: Asphalt/binder, Sand/binder

PERCENT

ND

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 03/15/2001

Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031264 Client Sample #: 2197-847-210

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Tan fibrous material, LAYER 2: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 70%
 LAYER 2: Cellulose 4%, Glass fibers 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Asphalt/binder, Sand/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21031265 Client Sample #: 2197-847-211

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Tan fibrous material, LAYER 2: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 70%
 LAYER 2: Cellulose 4%, Glass fibers 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Asphalt/binder, Sand/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21031266 Client Sample #: 2197-847-212

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Tan paint, LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 5%, Glass fibers 13%

NON-FIBROUS MATERIALS:

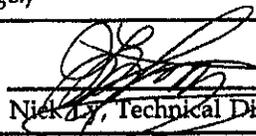
LAYER 1: Paint
 LAYER 2: Asphalt/binder

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-01888.00

Client Project #: 2197-01F

Number of samples: 56

Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	5%

Lab ID #: 21031267 Client Sample #: 2197-847-213

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Tan paint, LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 5%, Glass fibers 13%**NON-FIBROUS MATERIALS:**LAYER 1: Paint
LAYER 2: Asphalt/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	5%

Lab ID #: 21031268 Client Sample #: 2197-847-214

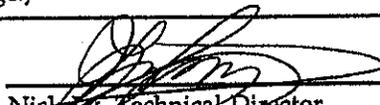
Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Tan fibrous material, LAYER 2: Black asphaltic built-up material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 80%
LAYER 2: Cellulose 3%, Glass fibers 25%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Asphalt/binder, Sand/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 03/15/2001
Date: 03/15/2001

 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031269 Client Sample #: 2197-847-215

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: LAYER 1: Tan fibrous material, LAYER 2: Black asphaltic built-up material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 80%
 LAYER 2: Cellulose 3%, Glass fibers 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler
 LAYER 2: Asphalt/binder, Sand/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031270 Client Sample #: 2197-847-216

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 20%

NON-FIBROUS MATERIALS:

Asphalt/binder, Sand/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21031271 Client Sample #: 2197-847-217

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 20%

NON-FIBROUS MATERIALS:

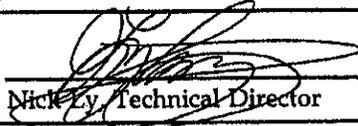
Asphalt/binder, Sand/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031272 Client Sample #: 2197-847-218

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material

OTHER FIBROUS MATERIALS:

Cellulose 10%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Asphalt/binder

PERCENT

4%

Lab ID #: 21031273 Client Sample #: 2197-847-219

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Sample not analyzed.

OTHER FIBROUS MATERIALS:

Sample not analyzed.

ASBESTOS TYPE:

*Sample not analyzed.

NON-FIBROUS MATERIALS:

Sample not analyzed.

PERCENT

ND

Lab ID #: 21031274 Client Sample #: 2197-847-220

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material

OTHER FIBROUS MATERIALS:

Cellulose 10%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Asphalt/binder

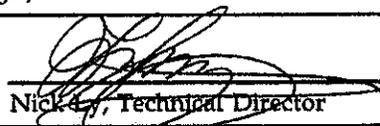
PERCENT

3%

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031275 Client Sample #: 2197-847-221

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Sample not analyzed.

OTHER FIBROUS MATERIALS:
 Sample not analyzed.

ASBESTOS TYPE:
 Sample not analyzed.

NON-FIBROUS MATERIALS:
 Sample not analyzed.

PERCENT
 ND

Lab ID #: 21031276 Client Sample #: 2197-847-222

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:
 Cellulose 3%, Glass fibers 27%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Asphalt/binder, Sand/binder

PERCENT
 ND

Lab ID #: 21031277 Client Sample #: 2197-847-223

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Black asphaltic material with granules

OTHER FIBROUS MATERIALS:
 Cellulose 3%, Glass fibers 27%

ASBESTOS TYPE:
 *None Detected

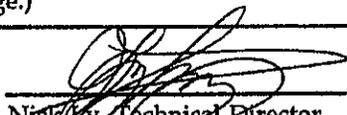
NON-FIBROUS MATERIALS:
 Asphalt/binder, Sand/binder

PERCENT
 ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01888.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21031278 Client Sample #: 2197-847-224

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: LAYER 1: Black asphaltic material with granules, LAYER 2: Tan fibrous material**OTHER FIBROUS MATERIALS:**LAYER 1: Cellulose 3%, Glass fibers 27%
LAYER 2: Cellulose 80%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Sand/binder
LAYER 2: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21031279 Client Sample #: 2197-847-225

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Black asphaltic material with granules**OTHER FIBROUS MATERIALS:**

Cellulose 3%, Glass fibers 27%

NON-FIBROUS MATERIALS:

Asphalt/binder, Sand/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21031280 Client Sample #: 2197-847-226

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: White chalky material with paper and paint**OTHER FIBROUS MATERIALS:**

Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

ASBESTOS TYPE:	PERCENT
*None Detected	ND

(Sample results are continued on the next page.)

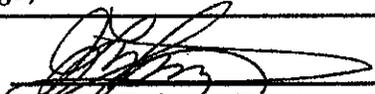
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 03/15/2001

Date: 03/15/2001


 Nick Ly, Technical Director

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031281 Client Sample #: 2197-847-227

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: White chalky material with paper and paint

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 7%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

PERCENT

ND

Lab ID #: 21031282 Client Sample #: 2197-847-228

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: White chalky material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%, Glass fibers 7%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder, Paint

PERCENT

ND

Lab ID #: 21031283 Client Sample #: 2197-847-229

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031284 Client Sample #: 2197-847-230

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031285 Client Sample #: 2197-847-231

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Tan sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031286 Client Sample #: 2197-847-232

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

(Sample results are continued on the next page.)

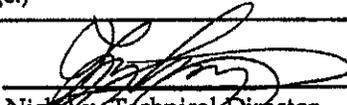
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 03/15/2001

Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031287 Client Sample #: 2197-847-233

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031288 Client Sample #: 2197-847-234

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031289 Client Sample #: 2197-847-235

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 03/15/2001

Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Honolulu, HI 96814
Attn.: Mr. William Harris
Project: Quad J-Bldg-847, Schofield Barracks, HawaiiNVL Batch Number: 21-01888.00
Client Project #: 2197-01F
Number of samples: 56

Lab ID #: 21031290 Client Sample #: 2197-847-236

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray sandy brittle material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031291 Client Sample #: 2197-847-237

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Gray sandy brittle material with paint**OTHER FIBROUS MATERIALS:**

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

ND

Lab ID #: 21031292 Client Sample #: 2197-847-238

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
Description: Black asphaltic material**OTHER FIBROUS MATERIALS:**

Cellulose 7%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Asphalt/binder

PERCENT

3%

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Wei Long Tai
Reviewed by: Nick LyDate: 03/15/2001
Date: 03/15/2001
Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031293 Client Sample #: 2197-847-239

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii
 Description: Sample not analyzed.

OTHER FIBROUS MATERIALS:

Sample not analyzed.

NON-FIBROUS MATERIALS:

Sample not analyzed.

ASBESTOS TYPE:

Sample not analyzed.

PERCENT

ND

Lab ID #: 21031294 Client Sample #: 2197-847-178

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:

LAYER 1: *None Detected
 LAYER 2: *None Detected
 LAYER 3: *None Detected

PERCENT

ND
 ND
 ND

Lab ID #: 21031295 Client Sample #: 2197-847-179

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

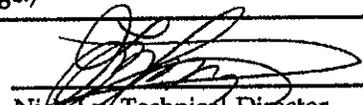
LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21031296 Client Sample #: 2197-847-180

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint with white soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21031297 Client Sample #: 2197-847-181

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

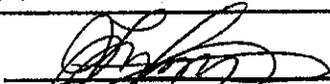
LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031298 Client Sample #: 2197-847-182

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21031299 Client Sample #: 2197-847-183

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 40%, Glass fibers 10%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

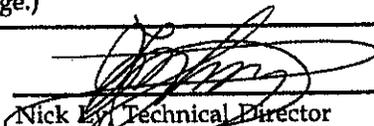
LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031300 Client Sample #: 2197-847-184

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint with white soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic,
 LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 30%, Glass fibers 20%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21031301 Client Sample #: 2197-847-185

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint with white soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic,
 LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 30%, Glass fibers 20%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

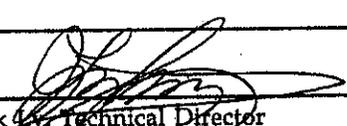
LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

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Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-847, Schofield Barracks, Hawaii

NVL Batch Number: 21-01888.00
 Client Project #: 2197-01F
 Number of samples: 56

Lab ID #: 21031302 Client Sample #: 2197-847-186

Sample Location: Quad J-Bldg-847, Schofield Barracks, Hawaii

Description: LAYER 1: Gray paint with white soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic,
 LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 30%, Glass fibers 20%
 LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Binder & filler, Mastic/binder
 LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

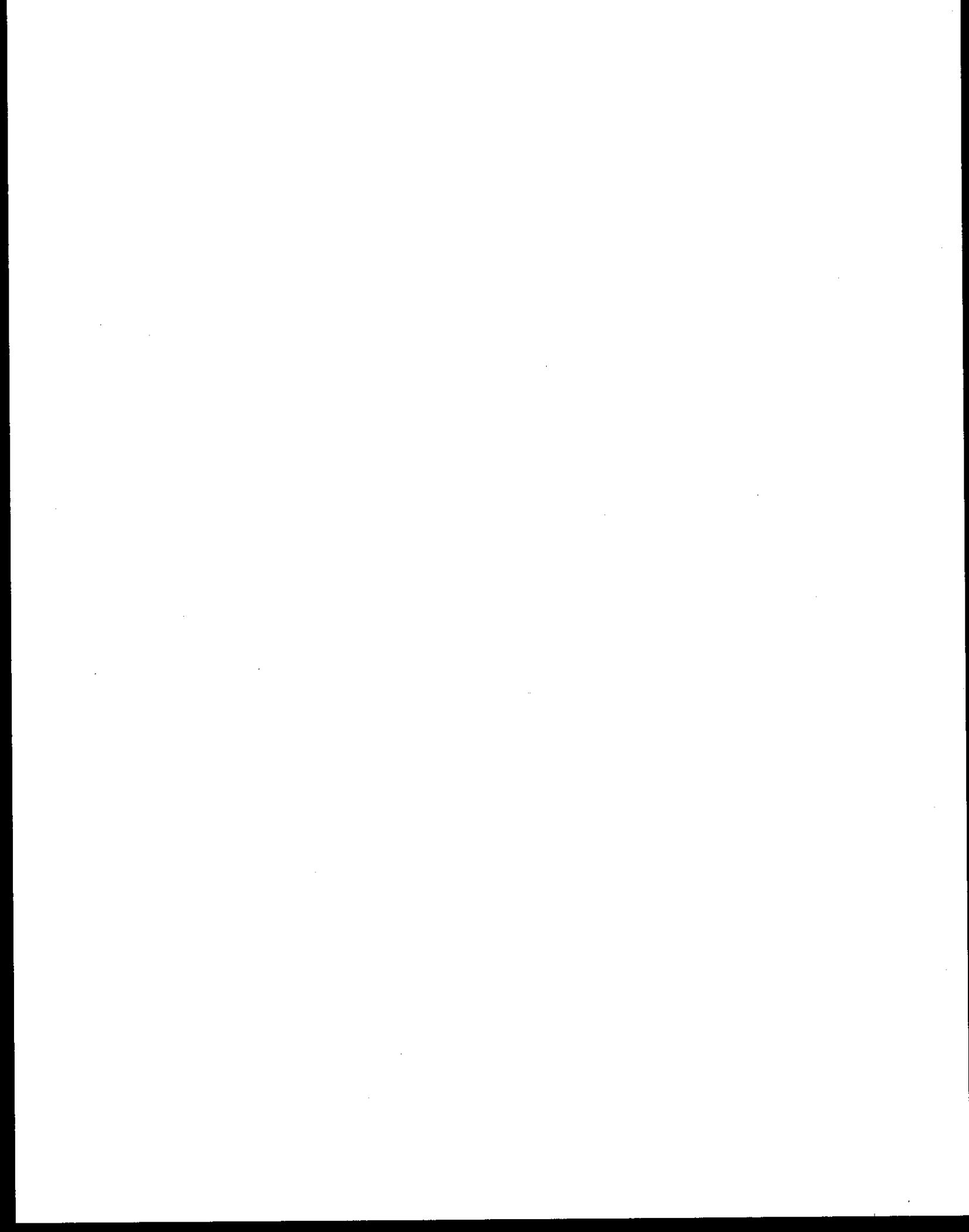
(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 03/15/2001
 Date: 03/15/2001


 Nick Ly, Technical Director

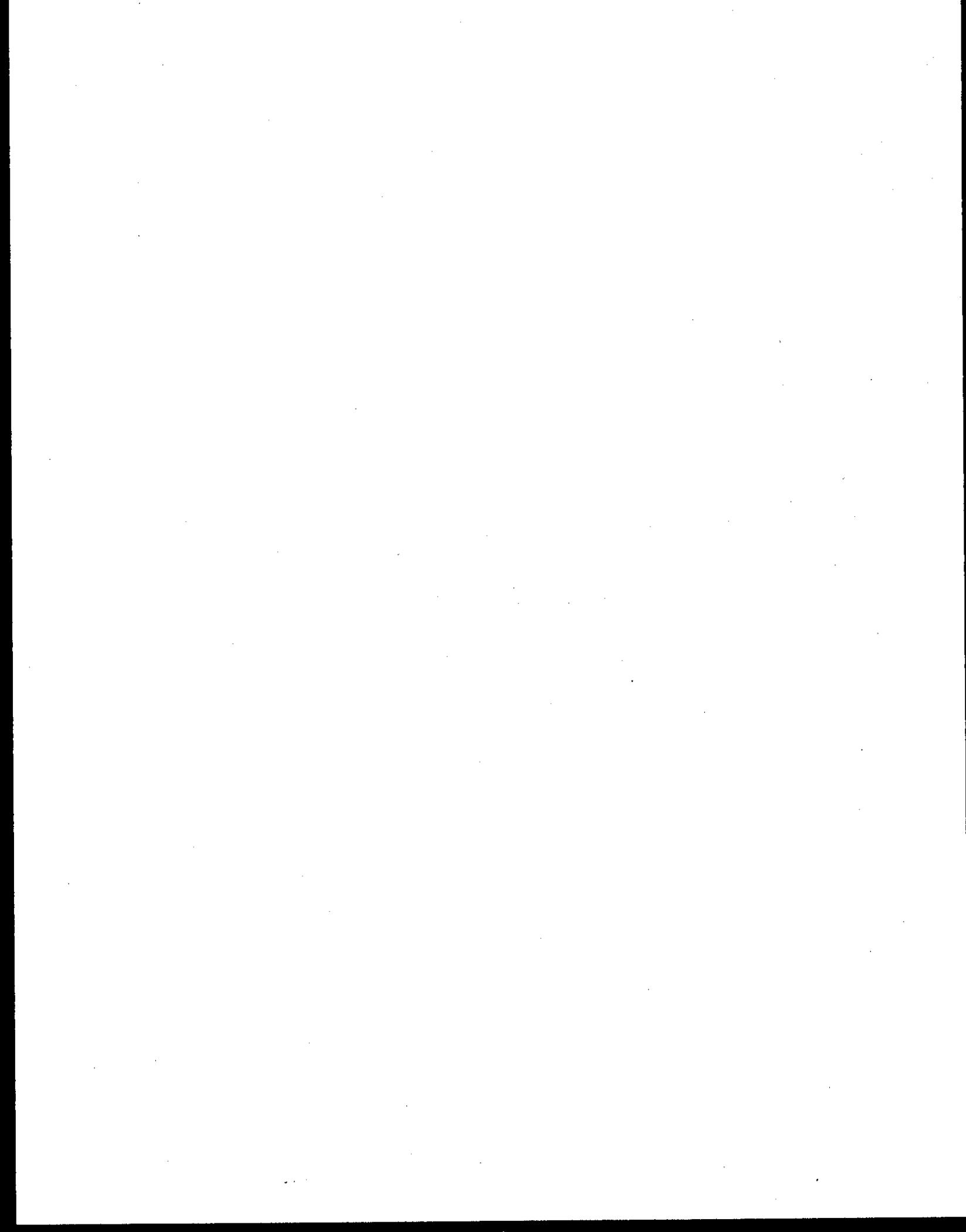
Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



APPENDIX B

BUILDING 855 "DIVARTY" DINING FACILITY

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii



I Introduction

Building 855 "DIVARTY" Dining Facility is a single story structure that serves as a dining facility (Divarty).

II Summary of Identified ACBM

Materials found to contain >1% asbestos are indicated in **bold** print, an asterisk preceding the material description indicates the material is considered friable or potentially friable. Materials found to contain <1% asbestos are indicated in *italic* print.

9"x9" Vinyl Floor Tile (VFT) - Green w/White Streaks and Mastic

12"x12" VFT - Brown w/White Streaks and Mastic

12"x12" VFT - Green and Mastic

12"x12" VFT - Brown Marbled and Mastic

***Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows 4"**

Upper Roof

Electrical Conduit Flashing/Sealant - Upper Roof

Ventilation Duct/Metal Flashing Coating - Silver - Upper Roof

Lower Roof

Asphaltic Patching Material - Lower Roof

Electrical Conduit Flashing/Sealant - Lower Roof

Ventilation Duct/Metal Flashing Coating - Silver - Lower Roof

III Survey Findings

EKNAs inspectors, Christine Arouh, Steven Chun, William Harris, Prudy Stoudt-McRea, Kennyson Thomas and Doug Tisdell (see Appendix C for Inspector Certificates) identified fifty (50) distinct material types and submitted one hundred forty (140) suspect samples for laboratory analysis. Material types sampled are listed below. Materials found to contain >1% asbestos are indicated in **bold** print, an asterisk indicates a friable or potentially friable material. Materials found to contain <1% asbestos are indicated in *italic* print.

9"x9" Vinyl Floor Tile (VFT) - Green w/White Streaks and Mastic

12"x12" VFT - Brown w/White Streaks and Mastic

12"x12" VFT - Green and Mastic

12"x12" VFT - Brown Marbled and Mastic

12"x12" VFT - White w/Brown Streaks and Mastic

12"x12" VFT - White w/Black Streaks and Mastic

12"x12" VFT - Grey w/White Streaks and Mastic

12"x12" VFT - Beige w/Grey Streaks and Mastic

12"x12" VFT - Lime Green w/Beige Streaks and Mastic

12"x12" VFT - Green w/White Streaks and Mastic

Gypsum Wall Board and Joint Compound, White

Gypsum Wall Board and Joint Compound, Brown

Grey Stone Mortar (Pillars, Walls)

Exterior Grey Plaster Eave System (Hollow),

see "Section IV - Remarks and Comments".

Brown Wall/Ceiling Plaster w/White Skim Coat

4" Cove Base - Black with Mastic

4" Cove Base - Brown with Mastic

4" Cove Base - Black/Grey with Mastic

2'x4' Suspended Ceiling Tile - Fissure w/Holes - Type I

2'x4' Suspended Ceiling Tile - Fissure w/Holes - Type II

White Sealant HVAC Fiberglass Duct

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - T-Fittings 4"

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Hangers 4"

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Runs 10"

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Run 3"

***Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows 4"**

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Hangers 10"

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows 5"

Sink Undercoating, Grey

Vibration Cloth (HVAC) - Black Vinyl

855 Water Heater Room

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbow
Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Runs
Hot Water Heater Tank Insulation - White

Upper Roof

Composition Built-up Roofing Material - Upper Roof
3"-4" Pipe Vent Sealant/Flashing - Upper Roof
18"-36" Diameter Ventilation Duct Flashing - Upper Roof
Electrical Conduit Flashing/Sealant - Upper Roof
Ventilation Duct/Metal Flashing Coating - Silver - Upper Roof

Lower Roof

Composition Built-up Roofing Material - Lower Roof
3"-4" Pipe Vent Sealant/Flashing - Lower Roof
18"-36" Diameter Ventilation Duct Flashing - Lower Roof
Composition Built-up Roofing Material - Flashing - Lower Roof
Asphaltic Patching Material - Lower Roof
Electrical Conduit Flashing/Sealant - Lower Roof
Ventilation Duct/Metal Flashing Coating - Silver - Lower Roof

Exterior

Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Saddle
Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbow
Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Run
Joint Adhesive/Sealant on Fiberglass Pipe Insulation (Metal Sleeve) - Elbow
Joint Adhesive/Sealant on Fiberglass Pipe Insulation (Metal Sleeve) - Run

IV Remarks and Comments

Review "Volume III, Asbestos Survey, Analytical and Report for: Quad I - Buildings 847 and 855 "DIVARTY" Dining Facility - Schofield Barracks, Oahu, Hawaii", "Discussion" and "Recommendations". See "Survey Methodology" for survey protocol.

Although the following material types are not considered asbestos-containing materials, caution should be exercised if/when disturbing these materials. Proposed work methods which may involve sawing, cutting, drilling abrading, etc. of these materials should be evaluated for their potential for airborne asbestos fiber release.

EKNA directed its analytical laboratory, NVL Laboratories of Seattle, to re-analyze the applicable samples by "NESHAP Point Count Method" for the following material type:

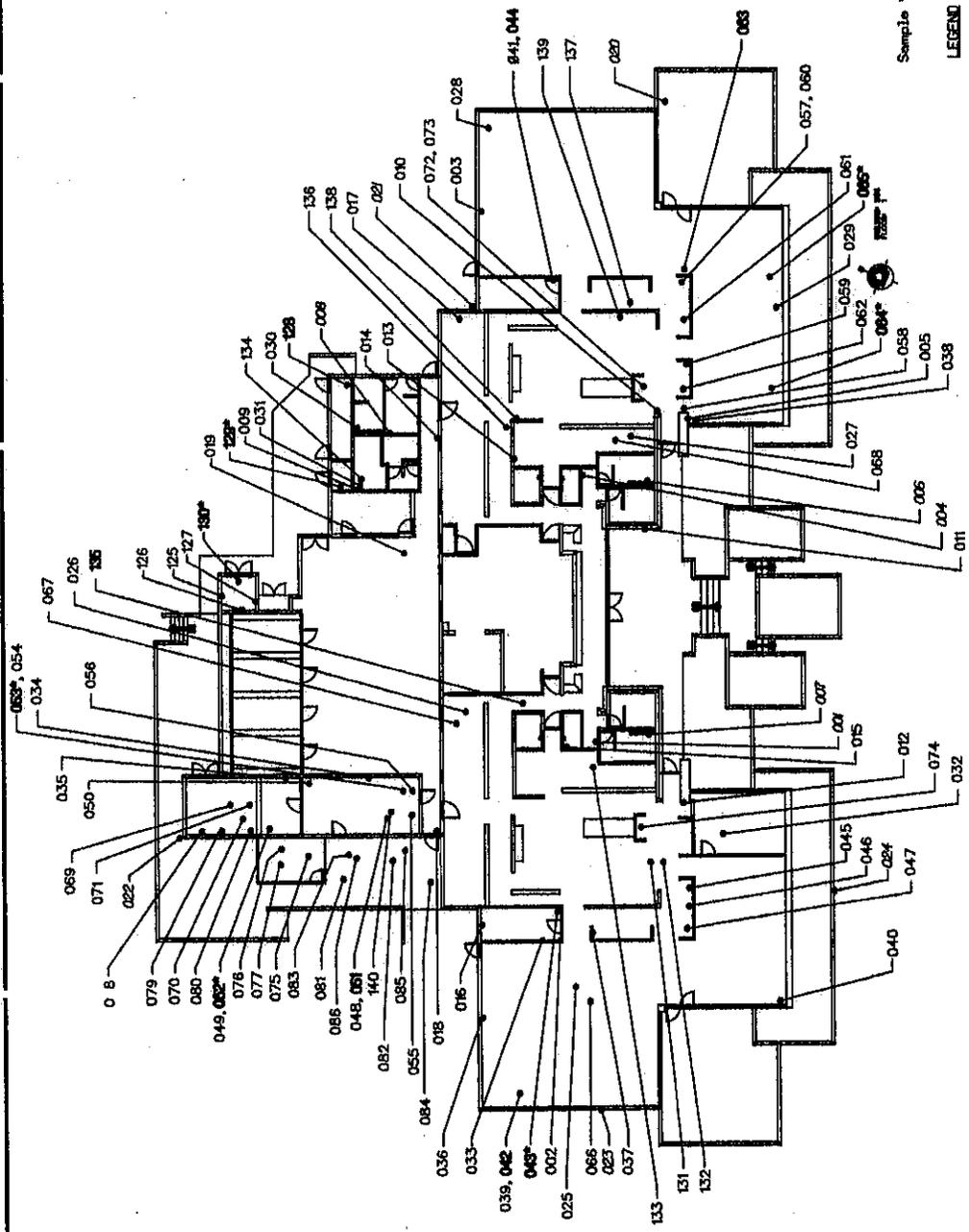
Exterior Grey Plaster Eave System (Hollow)

Analytical results will be forwarded upon receipt.

Building 855 "Divarty" Dining Facility

**Sample Locations
and
Extent of Identified ACM
Drawings**

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii



Sample * Prefix 2197-855-XXX

LEGEND

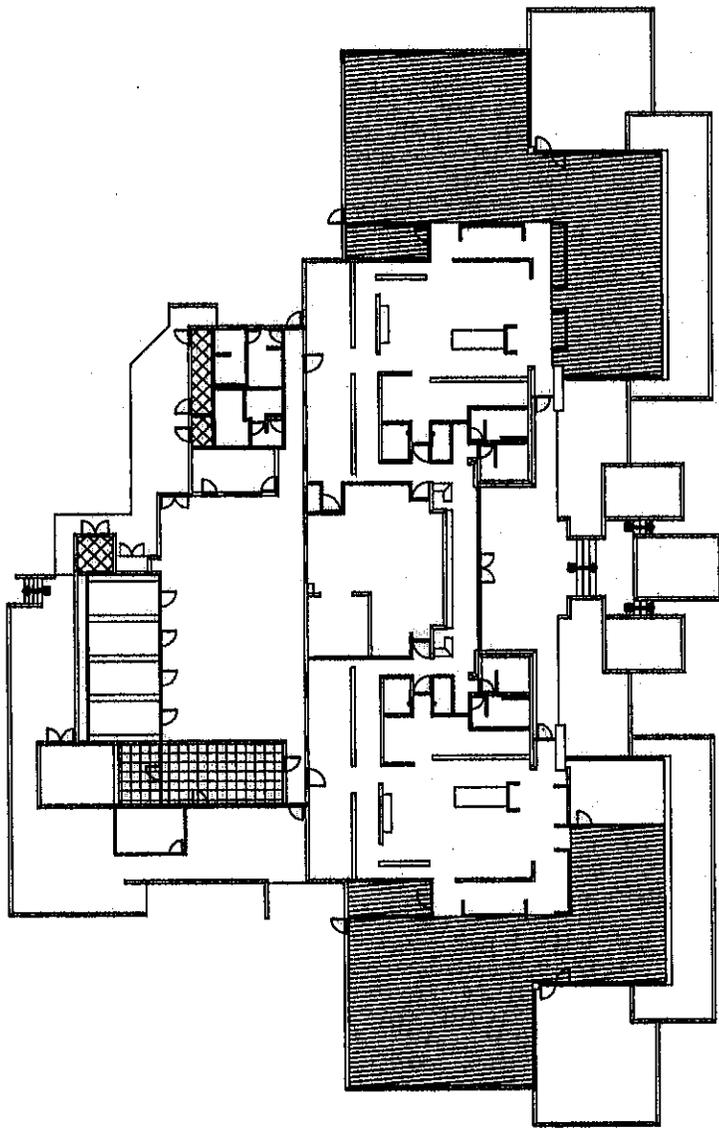
- XXX Non-Asbestos-Containing Sample Location
- XXX Asbestos-Containing Sample Location
- XXX* Homogeneous Asbestos-Containing Sample Locations
- XXX Asbestos-Containing Sample Location Less Than 1%

Edward K. Neely and Associates, Inc.
 815 PEARL STREET SUITE 300 HONOLULU HAWAII 96814
 Phone: (808) 531-0701

U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACA83-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 855

Sample Locations
 First Floor
 Figure
 1



Note:

Asbestos-Containing Joint Adhesive Sealant (Rough Off-White Coating) On
 Fiberglass Pipe Insulation (Runs, Elbows, Tees, Fittings, Hangers
 and Saddles, etc ... Exists Throughout Floor.)

LEGEND

-  Asbestos-Containing Floor Tile and Asbestos-Containing Mastuo (Single Layer)
-  Asbestos-Containing Mastuo Only (Multiple Layer)
-  Asbestos-Containing Floor Tile and Asbestos-Containing Mastuo (Multiple Layer)

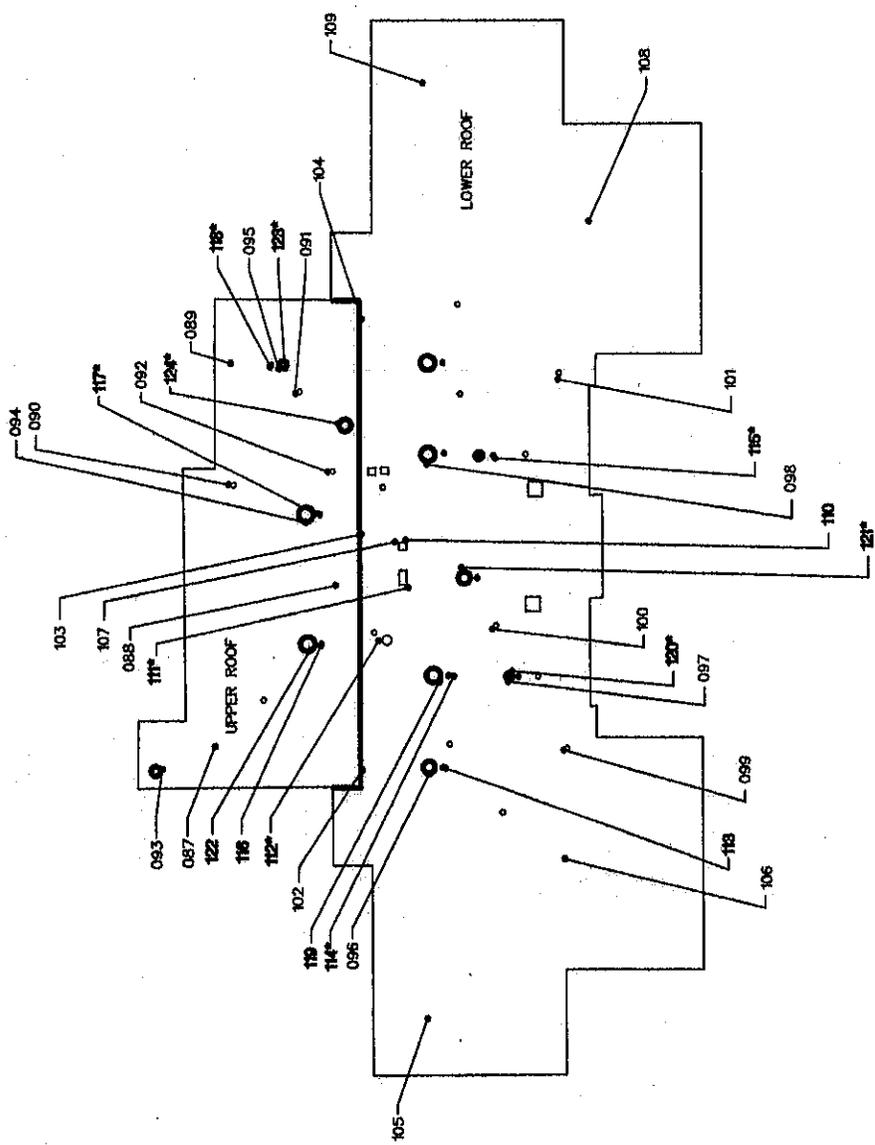
**Edward K. Noda
 and Associates, Inc.**
 65 PINE STREET SUITE 302, HAWAII, HAWAII, 96813
 Drawn by C. Arakaki Date: 02-07-01

U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACA83-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 855

Extent Of Identified ACBM
 First Floor

Figure
 2



Sample # Prefix 2197-855-XXX

LEGEND

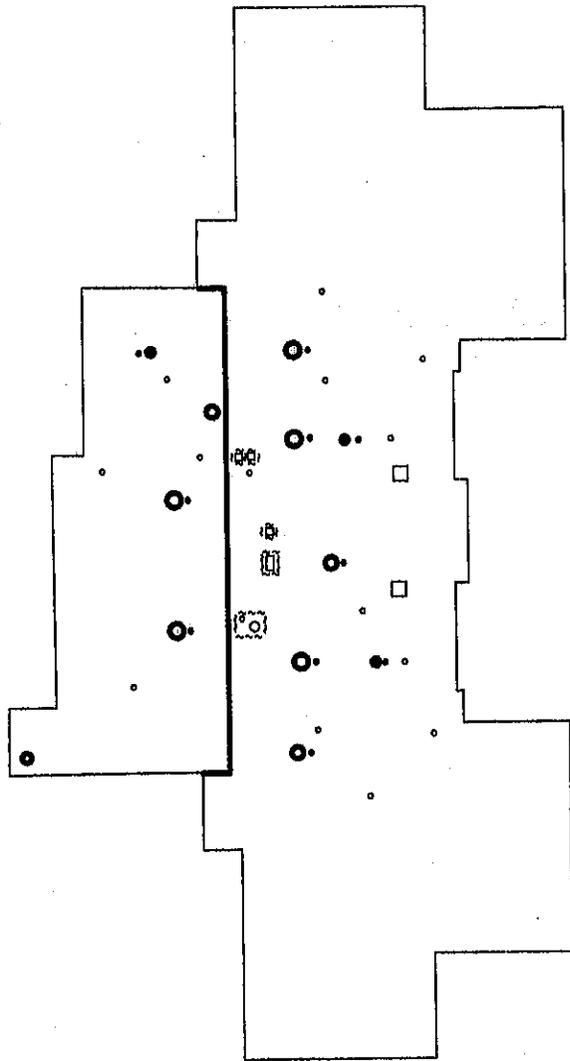
- XXX Non-Asbestos-Containing Sample Location
- XXX Asbestos-Containing Sample Location
- XXX* Homogeneous Asbestos-Containing Sample Locations
- XXX Asbestos-Containing Sample Location Less Than 1%

Edward K. Noda and Associates, Inc.
 615 KING STREET SUITE 300, HONOLULU, HAWAII 96814
 Phone: 808-531-0701

U. S. Army Corps of Engineers, Pacific Ocean Division
 Fort Shafter, Oahu, Hawaii
 Contract No: DACA83-00-D-0012, Task Order No: 0012

Asbestos Survey, Analysis and Report for
 Quad J, Building 855

Sample Locations
 Roof
 Figure
 3



LEGEND

- Asbestos-Containing Ventilation Duct/Metal Flashing Coating
- Asbestos-Containing Asphaltic Patching Material
- Asbestos-Containing Electrical Conduit Flashing

Figure
4

Extent of Identified ACBM
Roof

Asbestos Survey, Analysis and Report for
Quad J, Building 855

U. S. Army Corps of Engineers, Pacific Ocean Division
Fort Shafter, Oahu, Hawaii
Contract No: DACA83-00-D-0012, Task Order No: 0012

**Edward K. Noda
and Associates, Inc.**
605 PINE STREET, SUITE 300, HONOLULU, HAWAII 96814
Phone: 808-533-0701

Building 855 "Divarty" Dining Facility

Quantity Tables

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

Quantity Tables for Building 855

Each (ea.), linear feet (ln'), square feet (sq')

	1 st Floor
Asbestos-Containing Mastic and Associated NON-Asbestos-Containing Floor Tile	4,915 sq'
Asbestos-Containing Floor Tile and Mastic (Single Layer)	165 sq'
Asbestos-Containing Floor Tile and Mastic (Multi-Layer)	435 sq'

	Total Quantity
Electrical Conduit Flashing/Sealant - Upper Roof	5 ln'
Ventilation Duct/Metal Flashing Coating - Silver - Upper Roof	45 sq'
Asphaltic Patching Material - Lower Roof	20 sq'
Electrical Conduit Flashing/Sealant - Lower Roof	15 ln'
Ventilation Duct/Metal Flashing Coating - Silver - Lower Roof	220 sq'

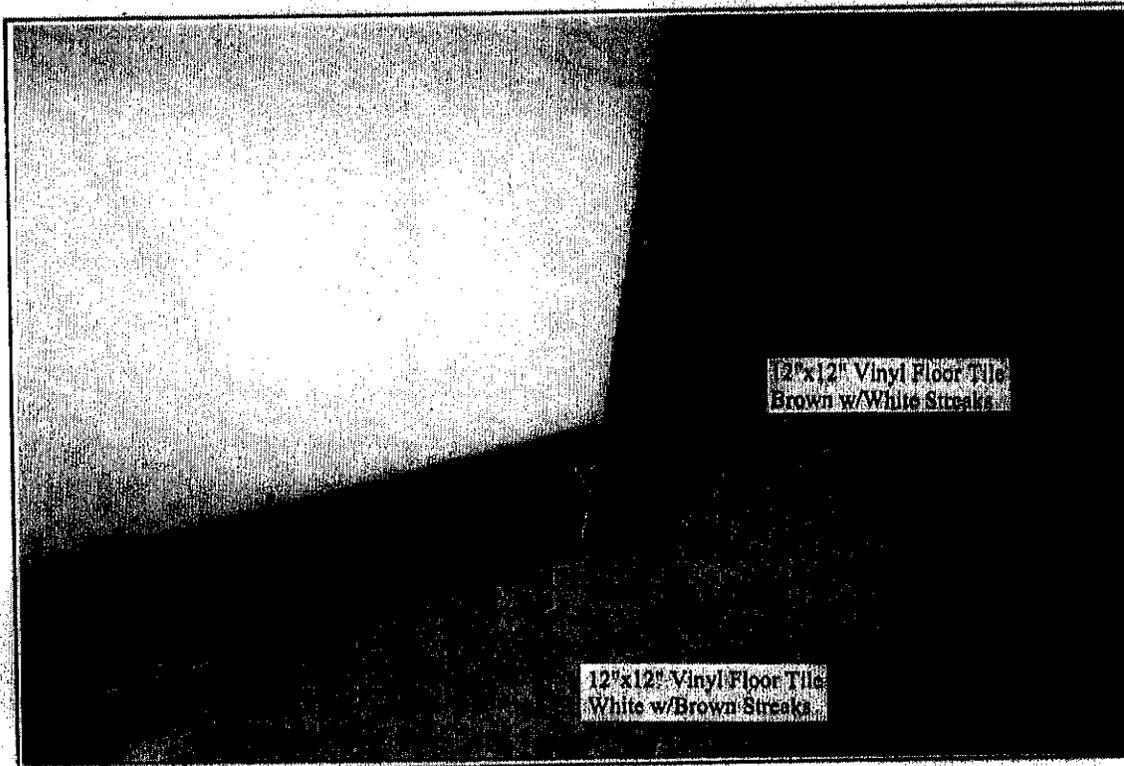
	Total Quantity
Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows 4"	25 ea.

Building 855 "Divarty" Dining Facility

Floor Tile Log

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

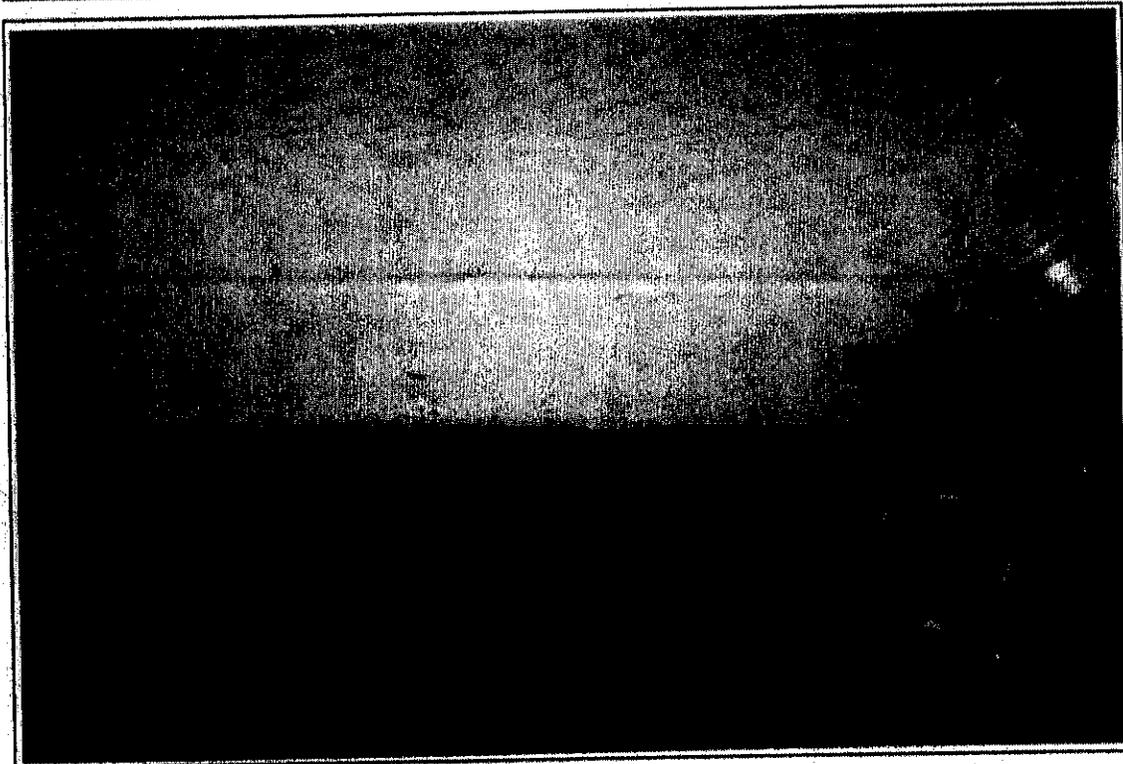
BUILDING 855 - FLOOR TILE LOG



12"x12" Vinyl Floor Tile
Brown w/White Streaks

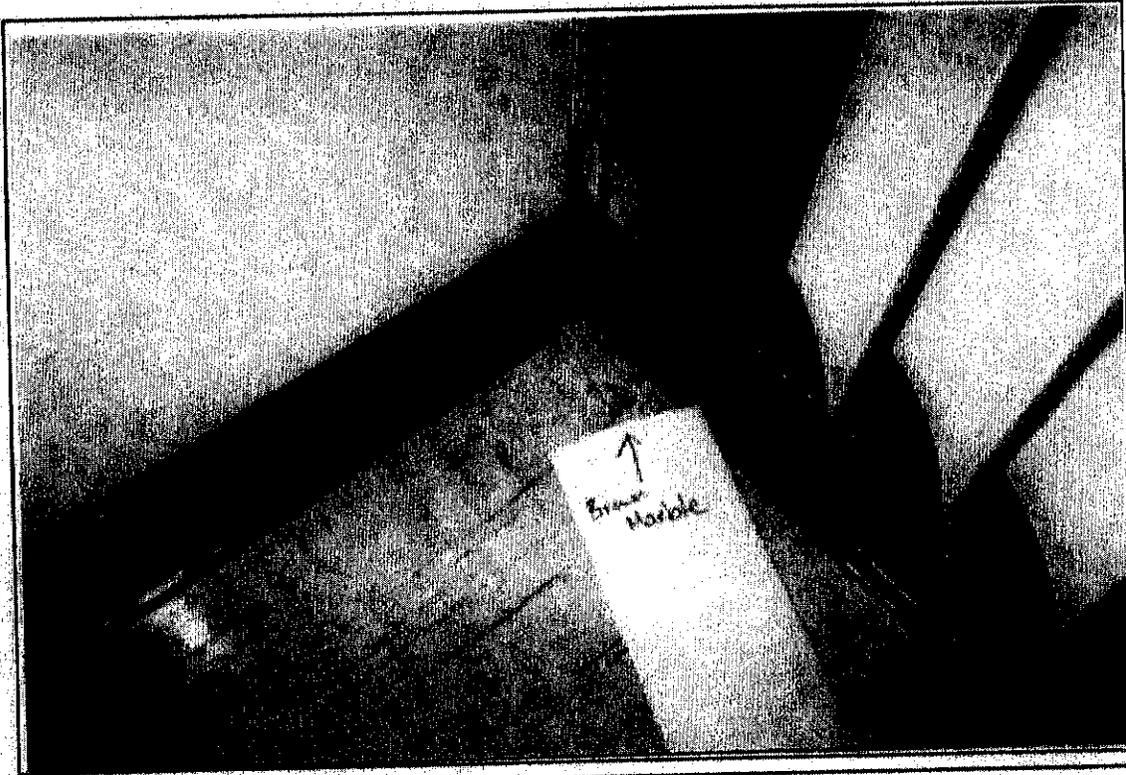
12"x12" Vinyl Floor Tile
White w/Brown Streaks

12"X12" Vinyl Floor Tile - Brown w/White Streaks
12"X12" Vinyl Floor Tile - White w/Brown Streaks

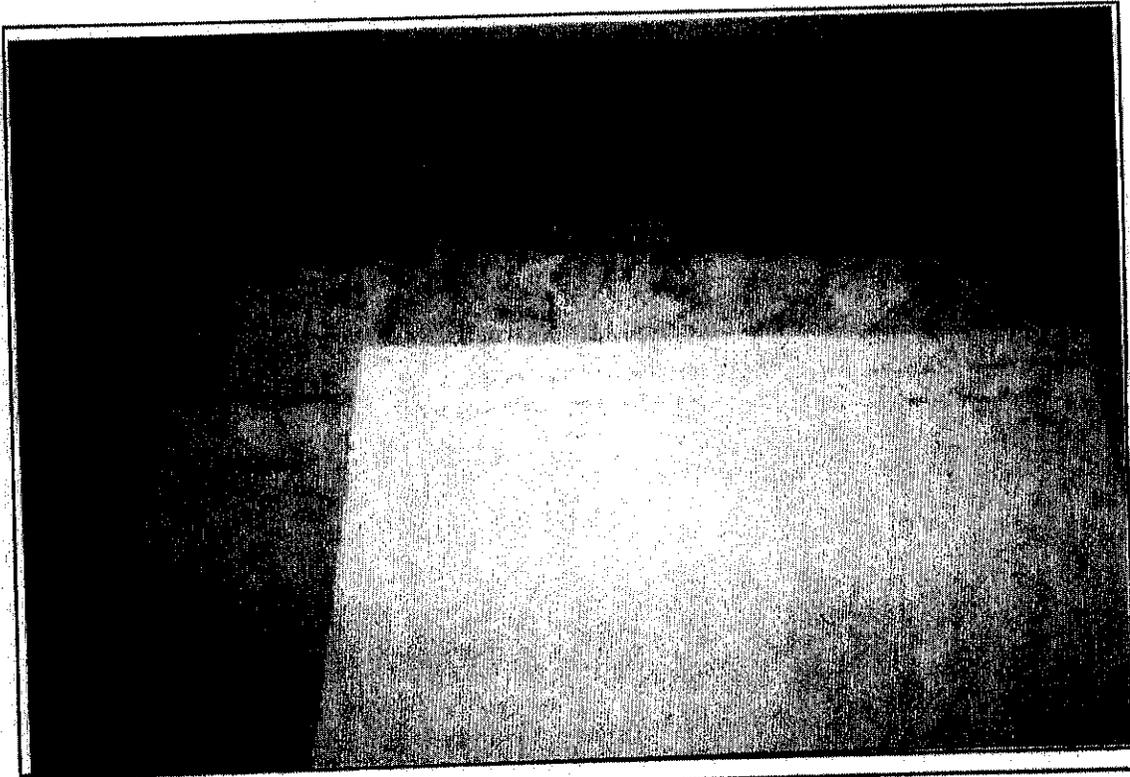


12"x12" Vinyl Floor Tile - White w/Black Streaks

BUILDING 855 - FLOOR TILE LOG

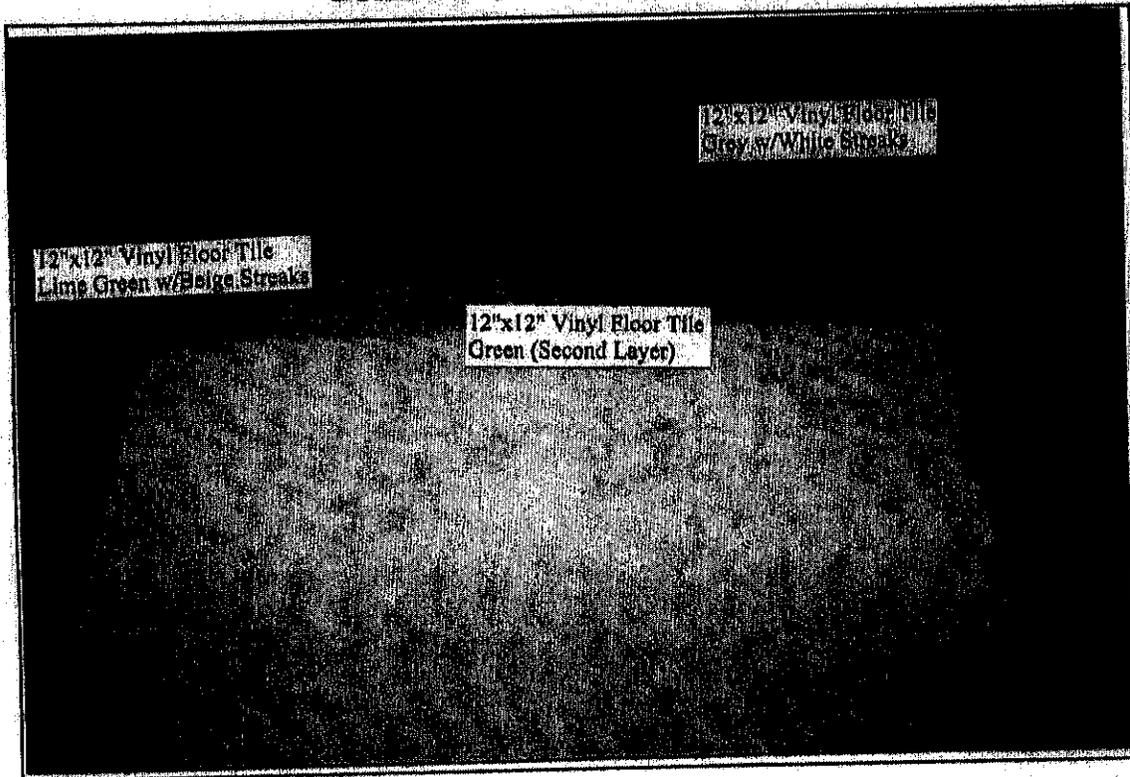


12"x12" Vinyl Floor Tile - Brown Marbled (Second Layer)



12"x12" Vinyl Floor Tile - Green w/White Streaks (Second Layer)

BUILDING 855 - FLOOR TILE LOG



12"x12" Vinyl Floor Tile - Lime Green w/Beige Streaks
12"x12" Vinyl Floor Tile - Green (Second Layer)
12"x12" Vinyl Floor Tile - Grey w/White Streaks

Building 855 "Divarty" Dining Facility

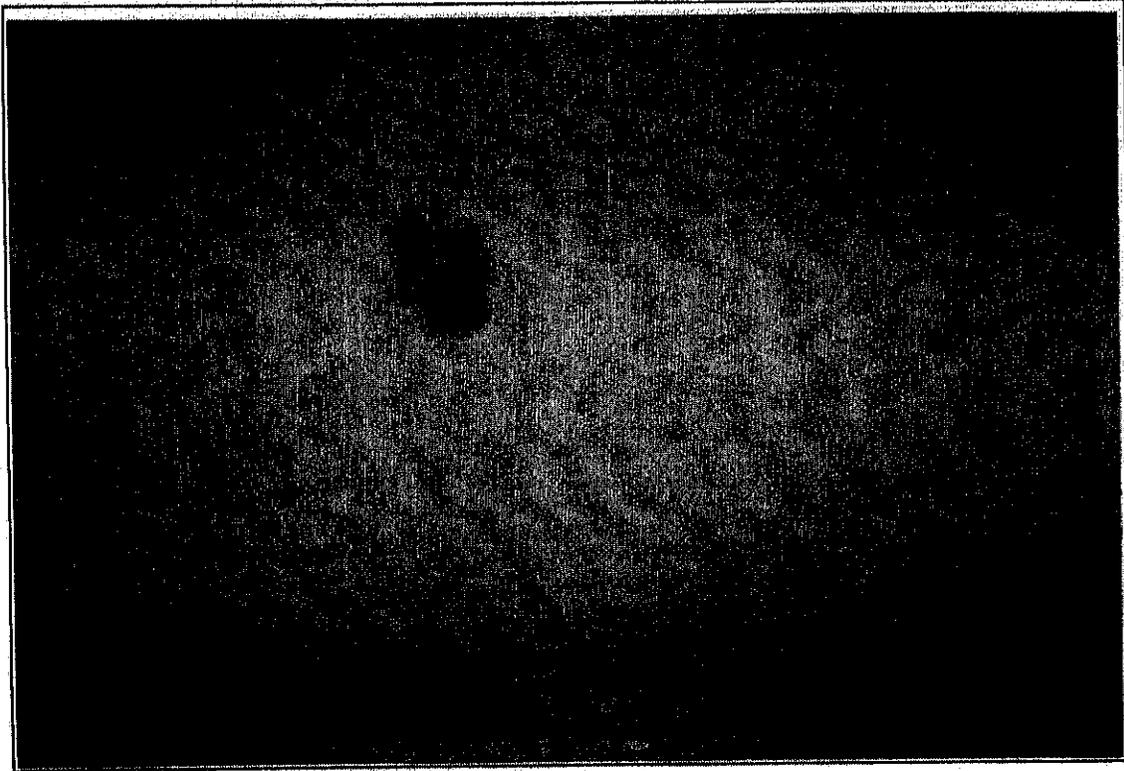
Photo Log

Volume III

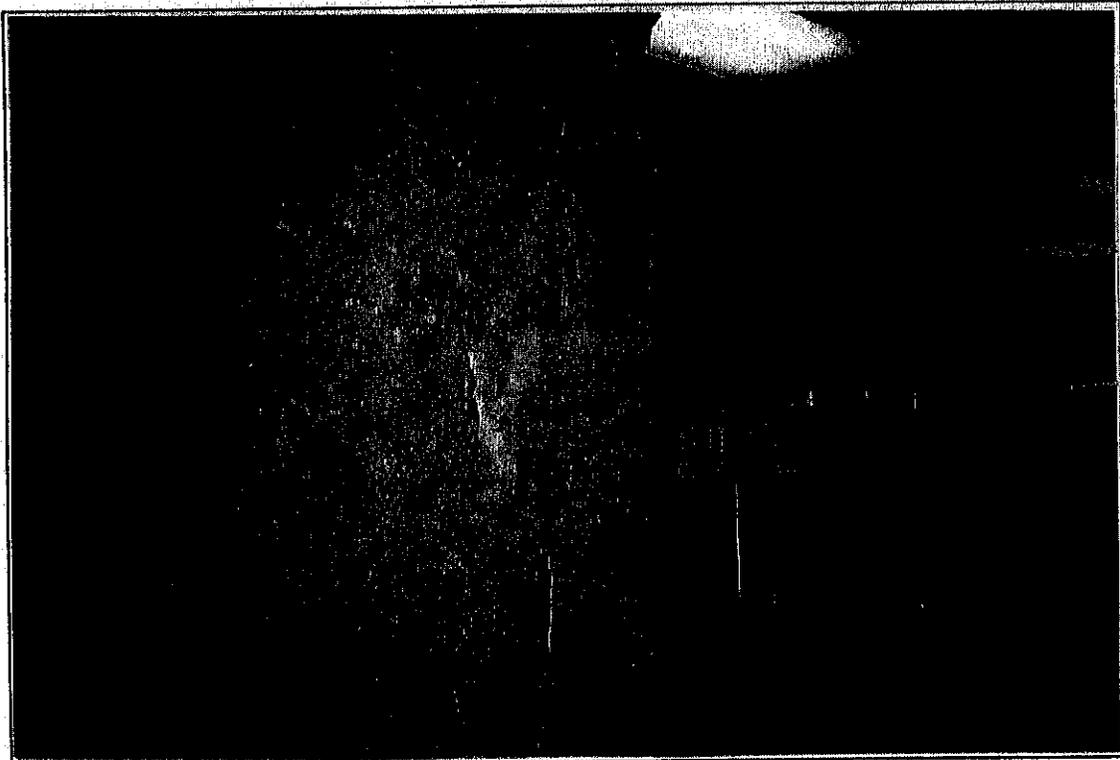
Final Asbestos Survey, Analysis and Report for:

Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

BUILDING 855 - PHOTO LOG



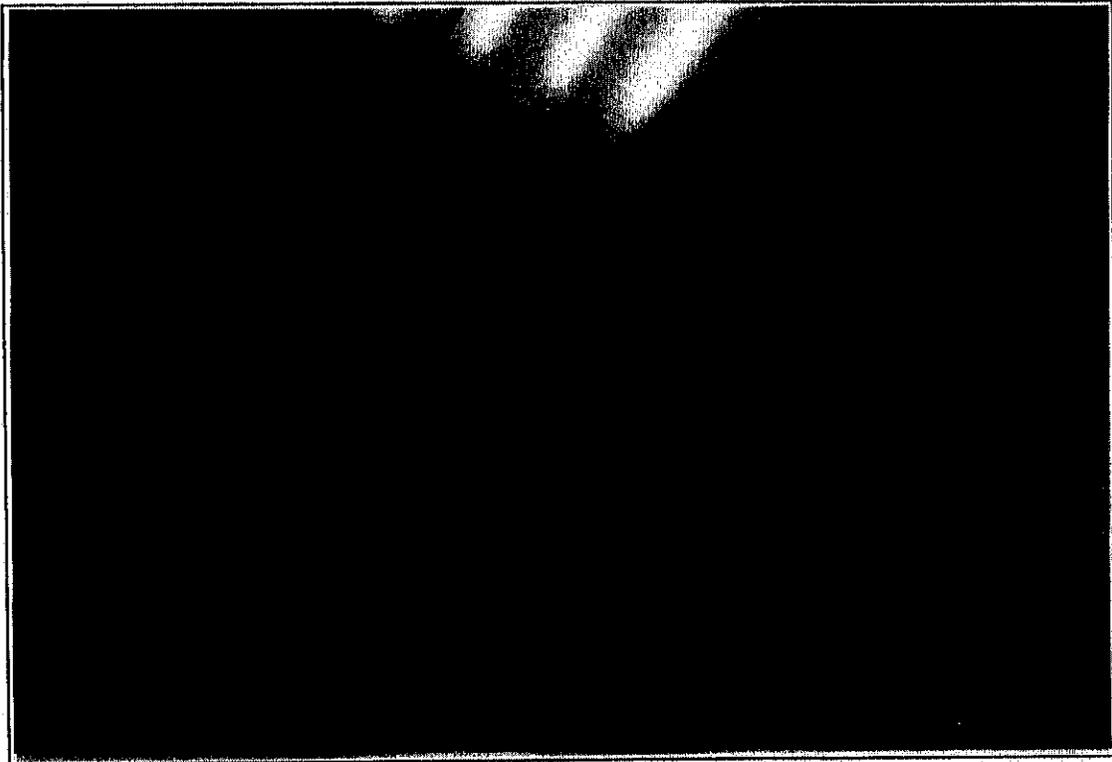
Gypsum Board with Joint Compound



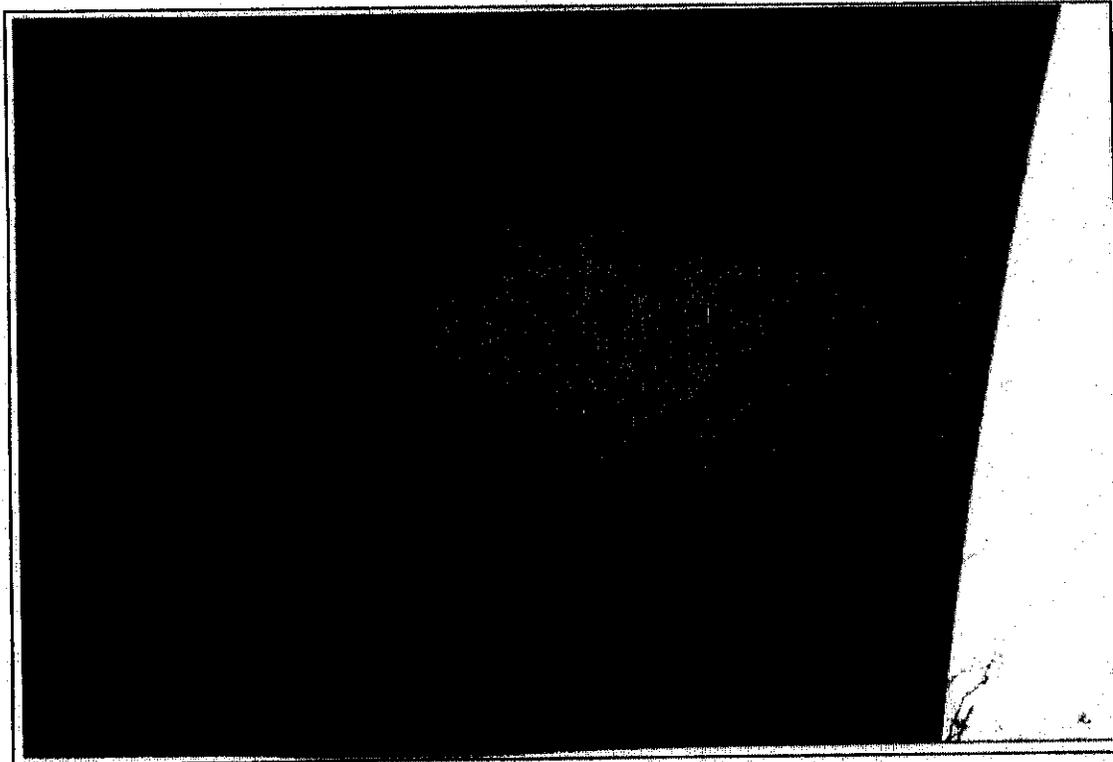
Grey Stone Mortar (Pillars, Walls)

**Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 1 of 9**

BUILDING 855 - PHOTO LOG



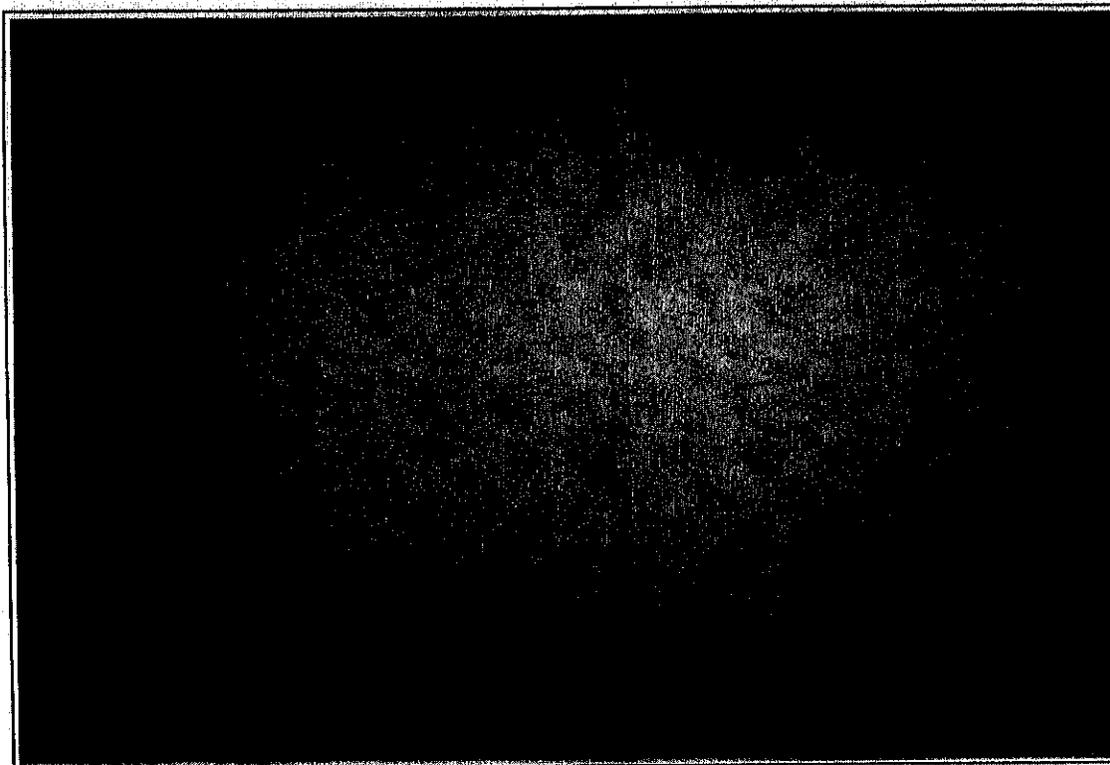
Brown Wall/Ceiling Plaster with White Skim Coat



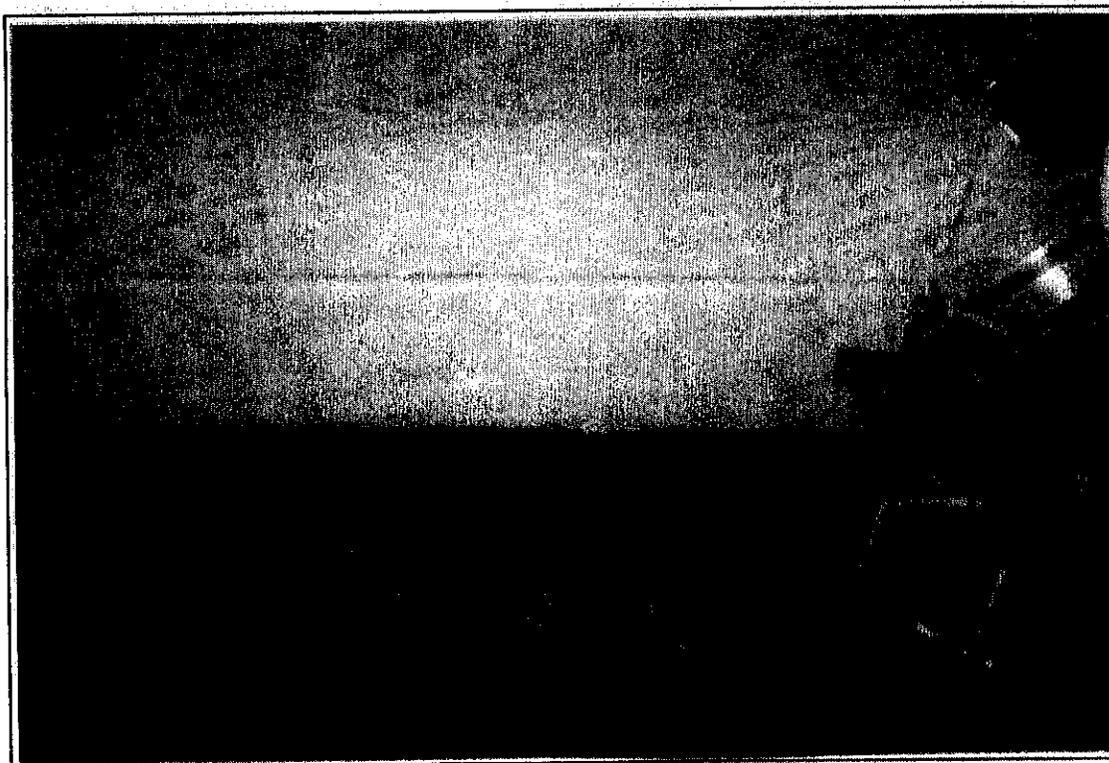
Exterior Grey Plaster Eave System (Hollow)

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 2 of 9

BUILDING 855 - PHOTO LOG



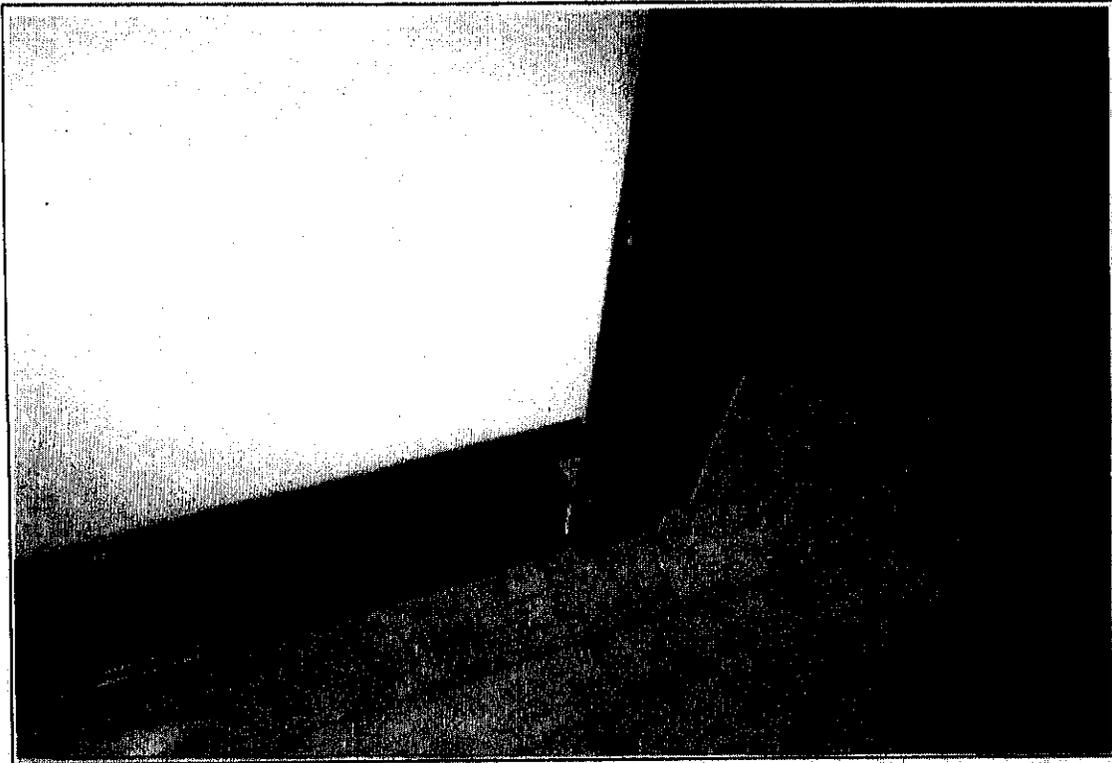
2'x4' Suspended Ceiling Panels - Fissure with Holes Pattern, Type I and Type II



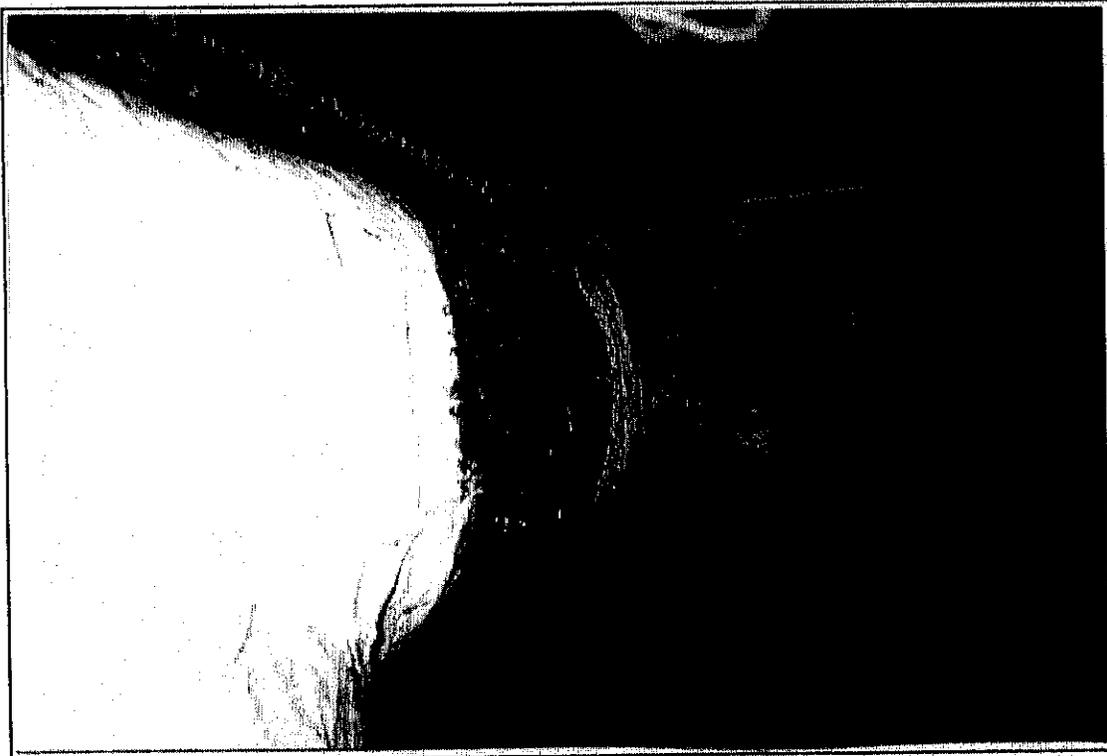
4" Cove Base - Brown with Mastic

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 3 of 9

BUILDING 855 - PHOTO LOG



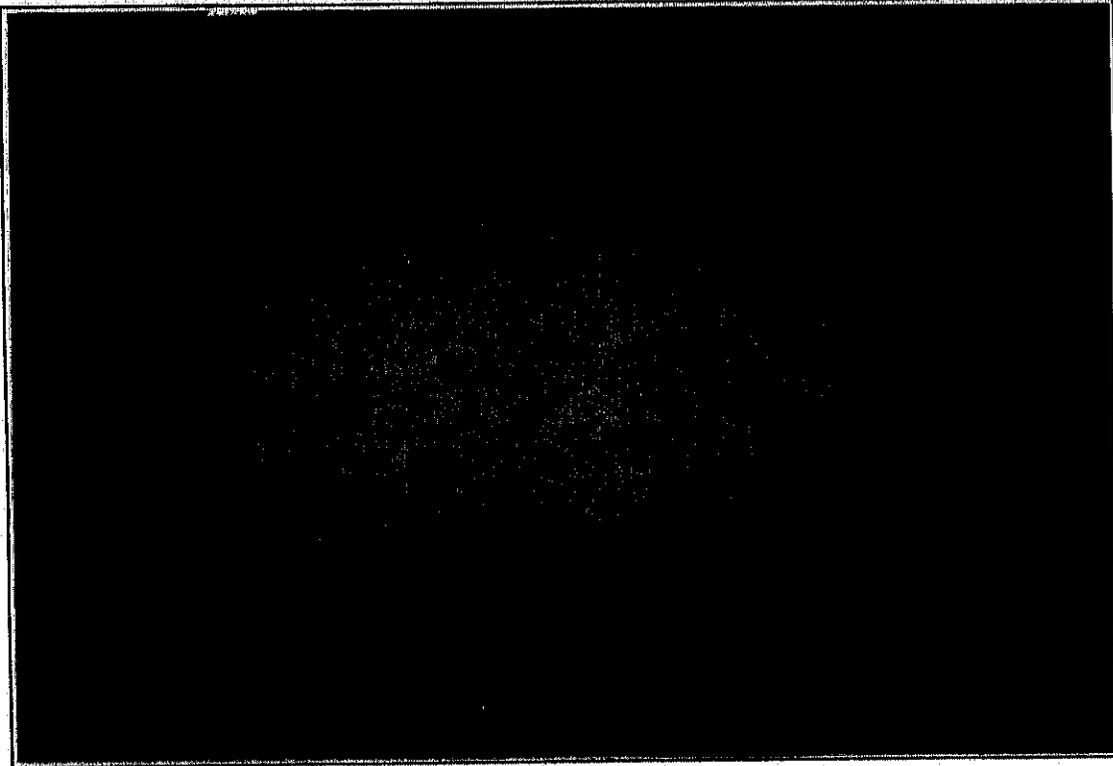
4" Cove Base - Black with Adhesive



White Sealant on HVAC Fiberglass Duct

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 4 of 9

BUILDING 855 - PHOTO LOG



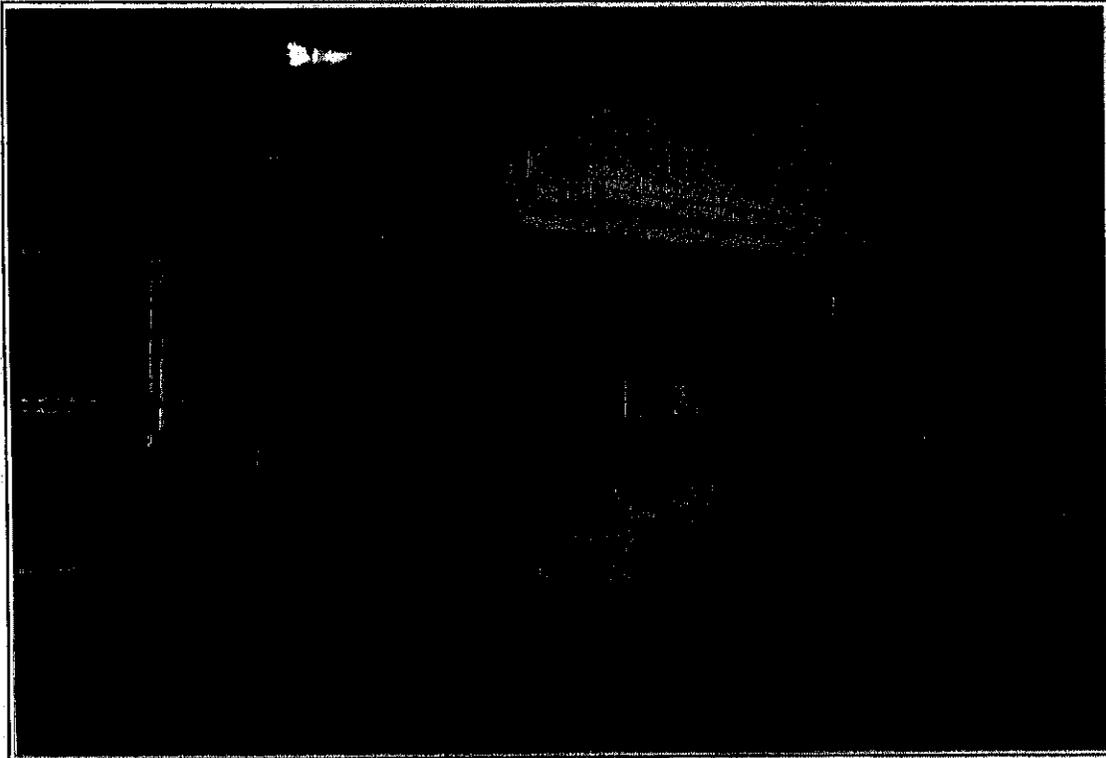
Water Heater Tank Insulation - White



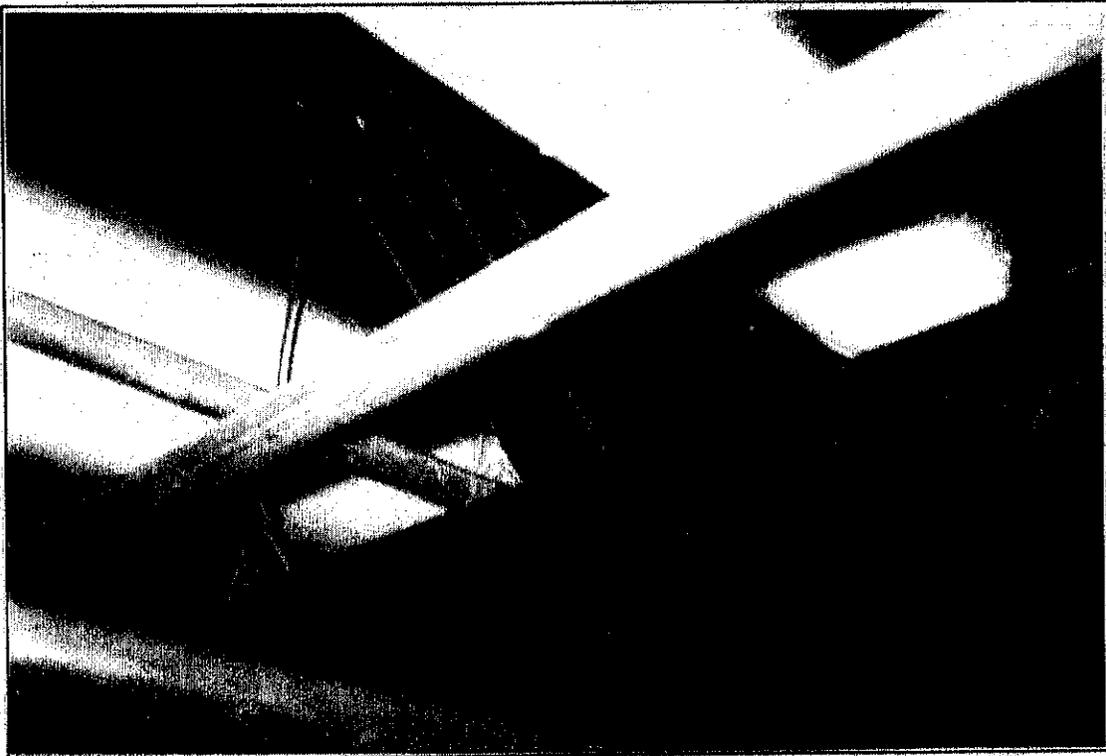
Sink Undercoating - Grey

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 5 of 9

BUILDING 855 - PHOTO LOG



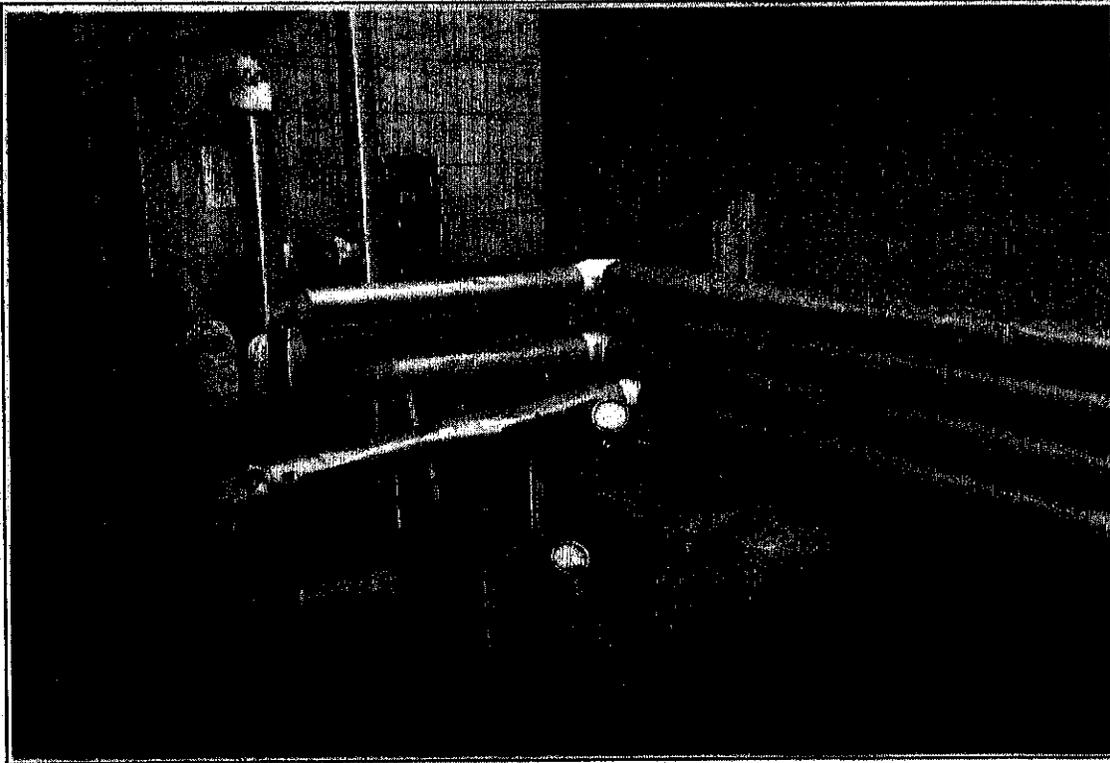
Vibration Cloth (HVAC) - Black Vinyl



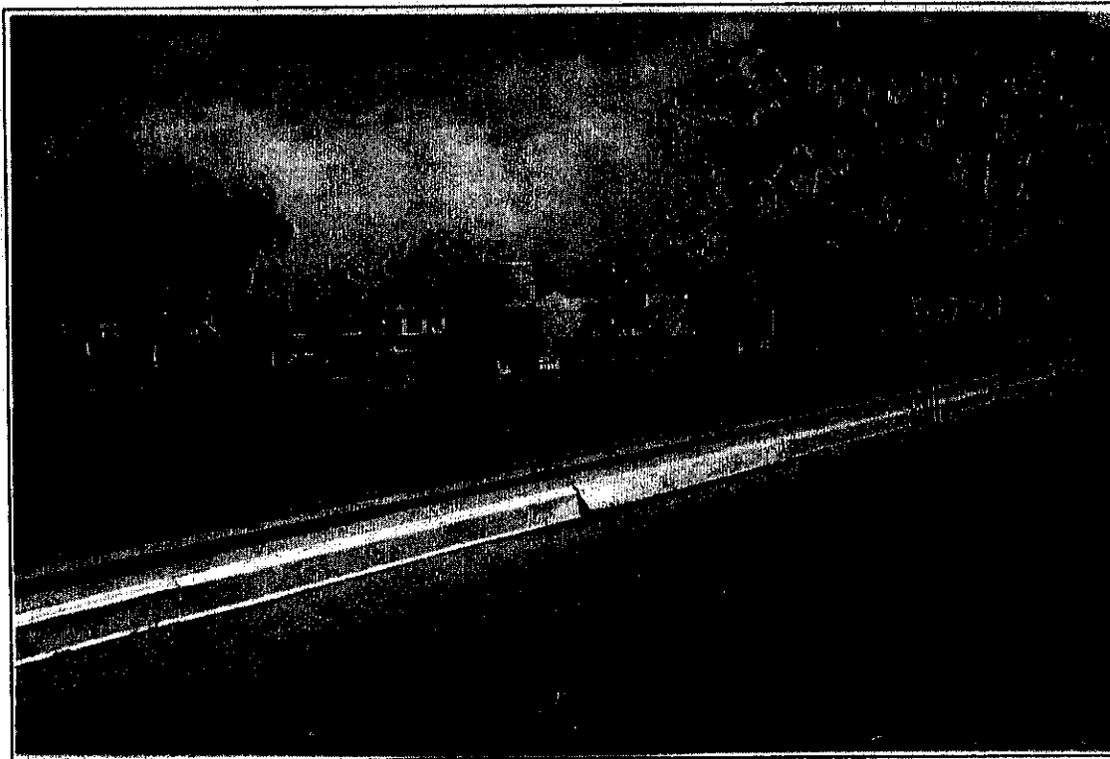
***Joint Adhesive/Sealant on Fiberglass Pipe Insulation - Elbows, Runs & Hangers**

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 6 of 9

BUILDING 855 - PHOTO LOG



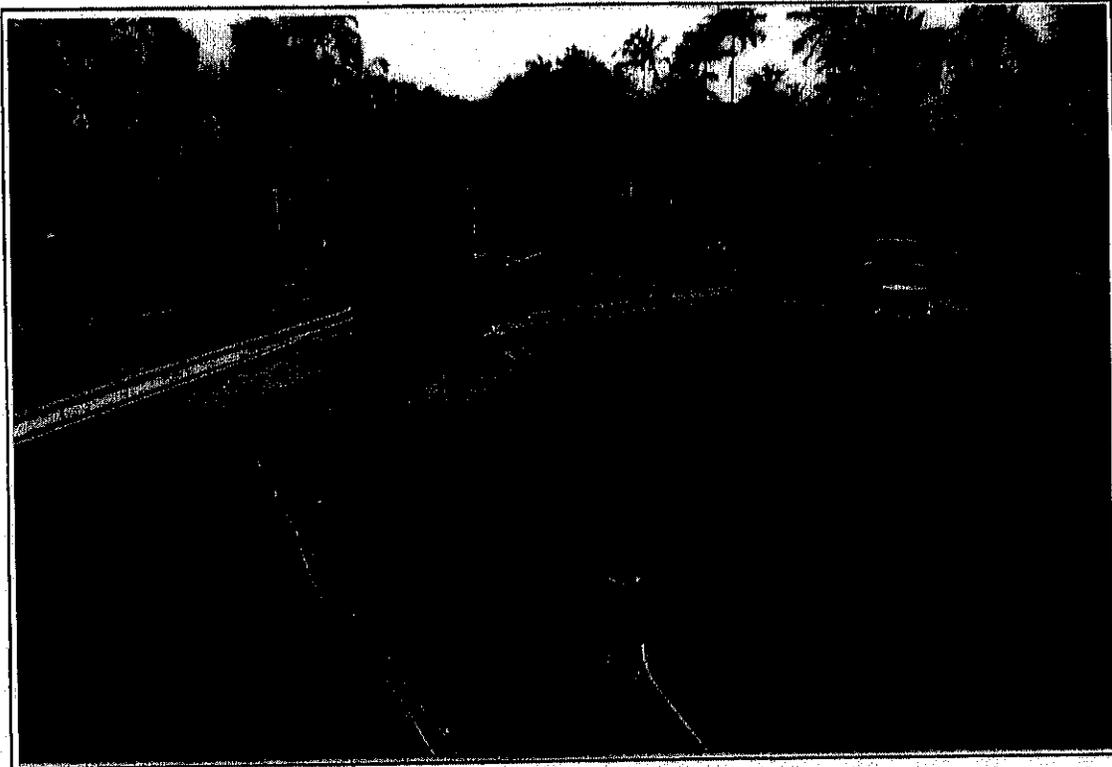
Fiberglass Pipe Insulation w/Joint Sealant in Metal Sleeve



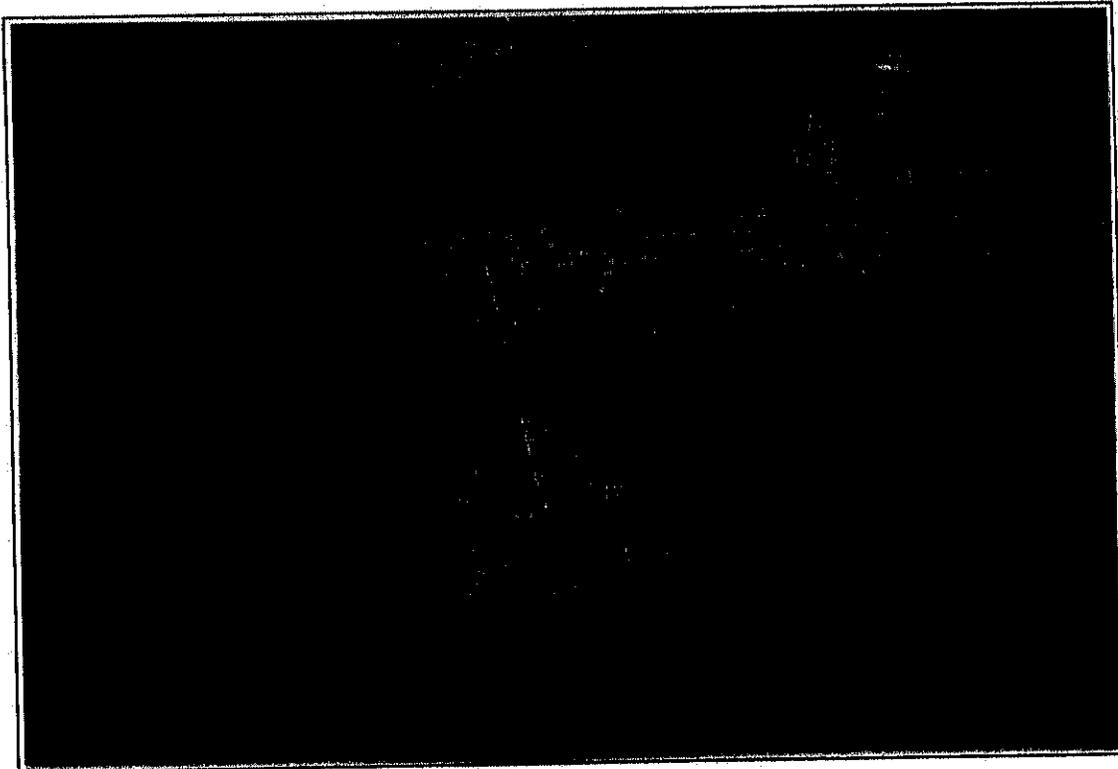
Composition Built-up Roofing Material - Upper Roof
Composition Built-Up Roofing Material/Flashing - Lower Roof

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 7 of 9

BUILDING 855 - PHOTO LOG



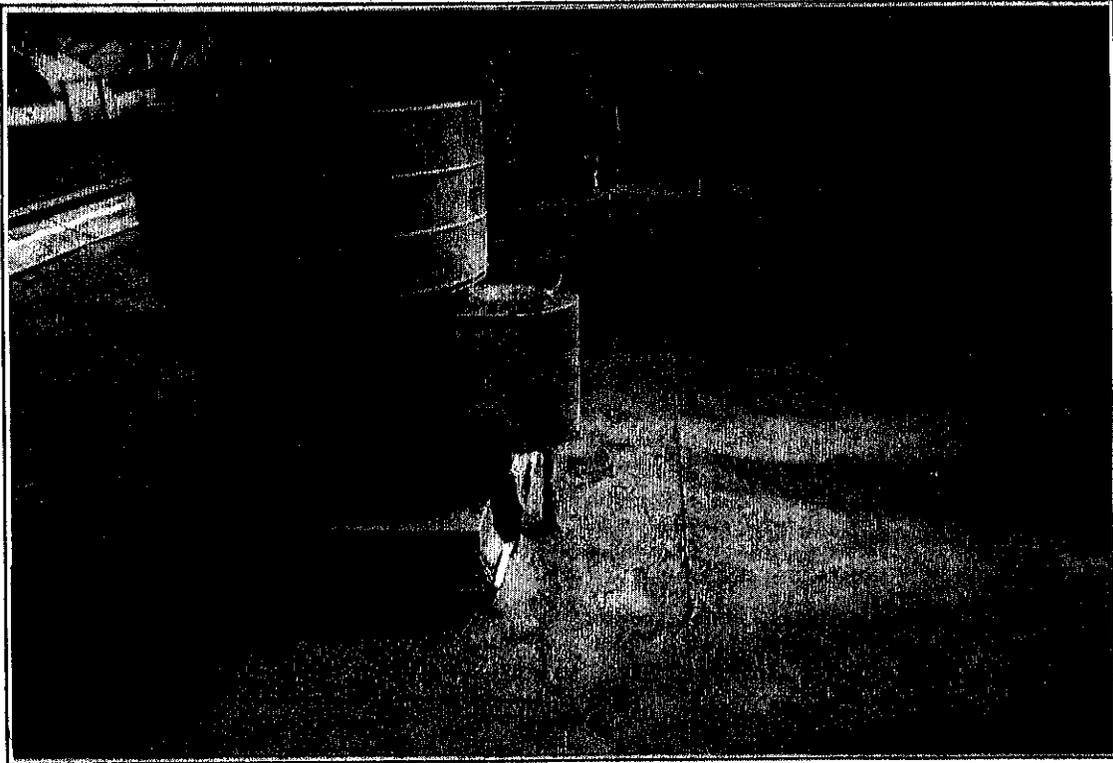
18" - 36" Ventilation Duct Coating - Silver - Duct Flashing- Upper/Lower Roof
3"-4" Dia. Pipe Vent - Mastic/Sealant



Asphaltic Patching Material - Lower Roof

Bold indicates identified material contains asbestos at a concentration greater than one percent (>1%).
Materials found to contain less than one percent (<1%) asbestos are indicated in *italic* print. Page 8 of 9

BUILDING 855 - PHOTO LOG



Electrical Conduit Flashing/Sealant - Upper/Lower Roof

Building 855 "Divarty" Dining Facility

**Chain of Custody Forms
and
Asbestos Bulk Analysis Forms**

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

21040710

EDWARD K. NODA AND ASSOCIATES

SHEET 1 OF 2

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-001	B	1	129	White Gypsum Board w/ Joint Compound
2	2197-855-002	B		110	
3	2197-855-003	B		139	
4	2197-855-004	B		129	
5	2197-855-005	B		140	
6	2197-855-006	B		137	Brown Gypsum Board w/ Joint Compound
7	2197-855-007	B		127	
8	2197-855-008	B		123	
9	2197-855-009	B		120	
10	2197-855-010	B		135	Grey Stone Mortar (Pillars, Walls)

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
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8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

ACCOUNTABILITY RECORD

*SAMPLE TYPE CODES

B = BULK MATERIAL
D = DEBRIS SAMPLE
SD/T = SURFACE DUST - TAPE SAMPLE
SD/V = SURFACE DUST - VACUUM SAMPLE
SD/G = SURFACE DUST - GRAB SAMPLE

APPROVAL SIGNATURE (PROJECT MANAGER):

REQUESTED COMPLETION DATE: Standard - 5 Day
JOB NO.: 2197-01F BATCH NO. EKN01360
CLIENT NAME: Wtl Chee / Corp of Engineers
SAMPLER'S NAME: Debra M. ... & Douglas Tisdell
SIGNATURE: [Signature]
DATE: 4/27-01 TIME COMPLETED: 4:30 DATE: 4-30-01
DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
RECEIVED BY: [Signature]
DATE: 5-1-01 TIME: 10:00 AM INITIALS: SM
ANALYZED BY: [Signature]
LAB Q.C. APPROVAL: [Signature]
DATE: 5/1/01

2104570

EDWARD K. NODA AND ASSOCIATES

SHEET 2 OF 4

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-011	B	1	141 WDI	Grey Stone Mortar (Pillars, walls)
2	2197-855-012	B		105 WDI	
3	2197-855-013	B		135 WCI	Brown Wall/Ceiling Plaster w/ White Skins Coat
4	2197-855-014	B		124 WAI	
5	2197-855-015	B		126 WBI	
6	2197-855-016	B		102 WCI	
7	2197-855-017	B		132 CIA	
8	2197-855-018	B		116 CIA	
9	2197-855-019	B	1	116 CIA	
10	2197-855-020	B	1	Ext "D" CIA	Exterior Grey Plaster Eave System (Hollow)

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
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10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDIT = SURFACE DUST - TAPE SAMPLE
- SDIV = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day
 JOB NO.: 2197-01F BATCH NO.: EKN01360
 CLIENT NAME: Wm Chee / Corp of Engineers
 SAMPLER'S NAME: Douglas Risdell, V. Ph.D.
 SIGNATURE: [Signature]
 DATE: 1/27/01 TIME COMPLETED: 17:30 DATE: 1-30-01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] TIME: [Signature] INITIALS: [Signature]
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature] DATE: [Signature]

APPROVAL SIGNATURE (PROJECT MANAGER):

2104070

SHEET 3 OF 14

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-021	B	1	EXT "B" CIA	Exterior Grey Plaster Eave System
2	2197-855-022	B	1	EXT "C" CIA	
3	2197-855-023	B	1	EXT "B" CIA	
4	2197-855-024	B	1	EXT "A" CIA	
5	2197-855-025	B	1	101 CIA	2'x4' Suspended Ceiling Panels - Emission of Holes Type I
6	2197-855-026	B	1	106 CIA	
7	2197-855-027	B	1	135 CIA	
8	2197-855-028	B	1	139 CIA	
9	2197-855-029	B	1	140 CIA	2'x4' Suspended Ceiling Panels - Emission of Holes Type II
10	2197-855-030	B	1	122 CIA	

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
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ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

ACCOUNTABILITY RECORD

*SAMPLE TYPE CODES
 B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SD/T = SURFACE DUST - TAPE SAMPLE
 SD/V = SURFACE DUST - VACUUM SAMPLE
 SD/G = SURFACE DUST - GRAB SAMPLE

APPROVAL SIGNATURE (PROJECT MANAGER):

REQUESTED COMPLETION DATE: 5 Day
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: William & Douglas Tisdell, V. Phillips
 SIGNATURE: [Signature]
 DATE: 4/23/01 TIME COMPLETED: 17:28 DATE: 4/30/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: _____ TIME: _____ INITIALS: _____
 ANALYZED BY: [Signature]
 LAB O.C. APPROVAL: _____ DATE: _____

2104070

SHEET 4 OF 14

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM#	MATERIAL DESCRIPTION
1	2197-855-031	B	1	C1A	2'x4' Suspended Ceiling Panels - Fiberglass w/ Holes Type II ↓
2	2197-855-032	B		C1A	↓
3	2197-855-033	B		WBI	4" Brown Cove Base w/ Adhesive ↓
4	2197-855-034	B		WPI	↓
5	2197-855-035	B		WPI	↓
6	2197-855-036	B		WCI	4" Black Cove Base w/ Adhesive - w/ Joint Compound ↓
7	2197-855-037	B		WCI	↓
8	2197-855-038	B		WCI	↓
9	2197-855-039	B		FIA	12"x12" Vinyl Floor Tile with Mastie - White w/ Brown Stripes ↓
10	2197-855-040	B		FIA	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
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10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: Return Standard - 5 Day
 JOB NO.: 2197-01E BATCH NO.: EKNA01360
 CLIENT NAME: Will Chase / Corp of Engineers
 SAMPLER'S NAME: William J. Phillips
 SIGNATURE: [Signature]
 DATE: 4/19/01 TIME COMPLETED: 17:30 DATE: 4/19/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] TIME: 12:26
 DATE: 4/19/01
 ANALYZED BY: [Signature]
 LAB O.C. APPROVAL: [Signature] DATE: 4/19/01

APPROVAL SIGNATURE (PROJECT MANAGER):

2104117

EDWARD K. NODA AND ASSOCIATES

SHEET 7 OF 14

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-061	B	1	139	12"x12" Vinyl Floor Tile w/ mastic - Green w/ white streaks
2	2197-855-062	B	1	135	12"x12" Vinyl Floor Tile w/ mastic - Green w/ white streaks
3	2197-855-063	B	1	139	12"x12" Vinyl Floor Tile w/ mastic - Brown w/ white streaks
4	2197-855-064	B	1	140	12"x12" Vinyl Floor Tile w/ mastic - Brown w/ white streaks
5	2197-855-065	B	1	140	12"x12" Vinyl Floor Tile w/ mastic - Brown w/ white streaks
6	2197-855-066	B	Plenum	101	White Sealant on HVAC Fiberglass Duct
7	2197-855-067	B	1	106	White Sealant on HVAC Fiberglass Duct
8	2197-855-068	B	1	135	White Sealant on HVAC Fiberglass Duct
9	2197-855-069	B	1	108	Hot Water Heater Tank Insulation - White
10	2197-855-070	B	1	108	Hot Water Heater Tank Insulation - White

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
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ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

ACCOUNTABILITY RECORD

*SAMPLE TYPE CODES
 B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SDIT = SURFACE DUST - TAPE SAMPLE
 SDIV = SURFACE DUST - VACUUM SAMPLE
 SDIG = SURFACE DUST - GRAB SAMPLE

APPROVAL SIGNATURE (PROJECT MANAGER):

REQUESTED COMPLETION DATE: March 5, 2001 BATCH NO. EKNA01360
 JOB NO.: 2197-01F CLIENT NAME: Wili Chee / Corp of Engineers
 SIGNATURE: [Signature] TIME: 11:30 INITIALS: [Initials]
 DATE: 4/27/01 TIME COMPLETED: 12:30 DATE: 4/30/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature]
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature]
 DATE: _____

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-071	B	108	T1A	Hot Water Heater Tank Insulation - White
2	2197-855-072	B	135	Sink	Sink Undercoating - Grey
3	2197-855-073	B	135	Sink	↓
4	2197-855-074	B	105	Sink	↓
5	2197-855-075	B	107	Vib	Vibration Clots (HVAC) - Black Vinyl
6	2197-855-076	B	107	Vib	↓
7	2197-855-077	B	107	Vib	↓
8	2197-855-078	B	108	PIA	Joint Sealant on Fiberglass Pipe Insulation - Elbow - under HTR Rm.
9	2197-855-079	B	108	PIA	↓ - Run - under HTR Rm.
10	2197-855-080	B	108	PIA	↓ - Elbow Under HTR Rm.

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
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ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

ACCOUNTABILITY RECORD

*SAMPLE TYPE CODES

B = BULK MATERIAL
D = DEBRIS SAMPLE
SDT = SURFACE DUST - TAPE SAMPLE
SDN = SURFACE DUST - VACUUM SAMPLE
SD/G = SURFACE DUST - GRAB SAMPLE

APPROVAL SIGNATURE (PROJECT MANAGER):

REQUESTED COMPLETION DATE: 5 Day STANDARD - 5 Day
JOB NO.: 2197-01F BATCH NO. EKNAD1360
CLIENT NAME: Will Cree / Corp of Engineers
SAMPLER'S NAME: John T. [Signature] & Douglas T. Phillips
SIGNATURE: [Signature] DATE: 01/27/01 TIME COMPLETED: 17:30 DATE: 2/20/01
DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
RECEIVED BY: _____ TIME: _____ INITIALS: _____
DATE: _____ ANALYZED BY: [Signature]
LAB Q.C. APPROVAL: _____ DATE: _____

2104121

EDWARD K. NODA AND ASSOCIATES

SHEET 9 OF 14

CHAIN OF CUSTODY FORM

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-081	B	1	Ext. B PIA	Joint Sealant on Fiberglass Pipe Insulation - Saddle - Grey
2	2197-855-082	B	1	PIA	Elbow Run
3	2197-855-083	B	1	PIA	Elbow
4	2197-855-084	B	1	PIA	Fiberglass Pipe Insulation w/ Joint Sealant on Metal Sleeve - Run
5	2197-855-085	B	1	PIA	Elbow
6	2197-855-086	B	1	Ext. B PIA	Elbow
7	2197-855-087	B	Roof	UPPER-PIA	Composition Built-up Roofing Material - Upper Roof
8	2197-855-088	B	1	PIA	↓
9	2197-855-089	B	1	PIA	↓
10	2197-855-090	B	Roof	IA	3"-4" # Pipe Vent Mastic / Sealant

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
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ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: Present Standard - 5 Day
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: Dennis Heppner & Douglas Isdell, V. Phillip
 SIGNATURE: [Signature]
 DATE: 4/27/01 TIME COMPLETED: 12:30 DATE: 4/30/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] TIME: 10:00 INITIALS: [Signature]
 ANALYZED BY: [Signature]
 LAB O.C. APPROVAL: [Signature] DATE:

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SDIT = SURFACE DUST - TAPE SAMPLE
- SDIV = SURFACE DUST - VACUUM SAMPLE
- SDIG = SURFACE DUST - GRAB SAMPLE

APPROVAL SIGNATURE (PROJECT MANAGER):

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-091	B	Roof	UPPER	3"-4" Pipe Vent Mastic / Sealant
2	2197-855-092	B			↓
3	2197-855-093	B			18" 3/8" Diameter Ventilation Duct Flashing
4	2197-855-094	B			↓
5	2197-855-095	B		UPPER	↓
6	2197-855-096	B		Lower	18" 3/8" Diameter Ventilation Duct Flashing
7	2197-855-097	B			↓
8	2197-855-098	B			↓
9	2197-855-099	B	Roof		3"-4" Pipe Vent Mastic / Sealant
10	2197-855-100	B		Lower	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
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ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

ACCOUNTABILITY RECORD

<p>*SAMPLE TYPE CODES</p> <p>B = BULK MATERIAL D = DEBRIS SAMPLE SD/T = SURFACE DUST - TAPE SAMPLE SD/V = SURFACE DUST - VACUUM SAMPLE SD/G = SURFACE DUST - GRAB SAMPLE</p>	<p>REQUESTED COMPLETION DATE: <u>12/30/01</u> BATCH NO.: <u>EKNA01360</u> JOB NO.: <u>2197-01F</u> CLIENT NAME: <u>Will Chee / Corp of Engineers</u> SAMPLER'S NAME: <u>Robert M. Tisdell</u> SIGNATURE: <u>[Signature]</u> DATE: <u>12/30/01</u> TIME COMPLETED: <u>12:30</u> DATE: <u>1/30/01</u> DELIVERED TO LAB BY: <u>FED-EX</u> DATE: <u>1/30/01</u></p>
<p>APPROVAL SIGNATURE (PROJECT MANAGER):</p>	

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] TIME: 10:00 AM INITIALS: RTD
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature] DATE: _____

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-111	B	Roof	Lower R1A	Asphaltic Patching Material - Lower Roof ↓
2	2197-855-112	B		R1A	↓
3	2197-855-113	B		IA	Electrical Conduit Flashing/Sealant ↓
4	2197-855-114	B	↓	IA	↓
5	2197-855-115	B	Roof	Lower IA	Electrical Conduit Flashing/Sealant - Upper Roof ↓
6	2197-855-116	B	Roof	Upper IA	↓
7	2197-855-117	B	↓	IA	↓
8	2197-855-118	B	↓	IA	↓
9	2197-855-119	B	Lower	IA	Ventilation Duct Coating - Silver - Lower Roof ↓
10	2197-855-120	B	↓	IA	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Attn. Kenny Thomas

*SAMPLE TYPE CODES

B = BULK MATERIAL
 D = DEBRIS SAMPLE
 SDIT = SURFACE DUST - TAPE SAMPLE
 SDIV = SURFACE DUST - VACUUM SAMPLE
 SDIG = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: EMM Standard - 5 Day
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: William Chee & Douglas Tisdell
 SIGNATURE: [Signature]
 DATE: 4/27/01 TIME COMPLETED: 12:30 DATE: 4/30/01
 DELIVERED TO LAB BY: [Signature] FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVED BY: [Signature] INITIALS: RCW
 DATE: 5/1/01 TIME: 10:00
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature] DATE:

APPROVAL SIGNATURE (PROJECT MANAGER):

ASBESTOS BULK SAMPLE CHAIN OF CUSTODY FORM

BLDG. NAME & PROJECT NAME: **Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii**

SET	SAMPLE I.D. NO.	TYPE*	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-121	B	Roof	Lower	1A Ventilation Duct Coating - Silver - Lower Roof
2	2197-855-122	B	↓	Upper	1A Ventilation Duct Coating - Silver - Upper Roof
3	2197-855-123	B	↓	↓	↓
4	2197-855-124	B	Roof	↓	↓
5	2197-855-125	B	1	11S WCI	4" Black/Grey Cove Base - Storage Room in Rear
6	2197-855-126	B	1	11S WBI	↓
7	2197-855-127	B	1	11S WAI	↓
8	2197-855-128	B	1	11A FIA	9" x 9" Vinyl Floor Tile - Green of White Streaks
9	2197-855-129	B	1	11B FIA	↓
10	2197-855-130	B	1	11S FIA	↓

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

***SAMPLE TYPE CODES**

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 12/27/01 Standard - 5 Day
 JOB NO.: 2197-01F BATCH NO. EKNA01360
 CLIENT NAME: Will Chee / Corp of Engineers
 SAMPLER'S NAME: Douglas Tisdell
 SIGNATURE: [Signature] TIME COMPLETED: 12:30 DATE: 1/30/01
 DELIVERED TO LAB BY: [Signature] DATE: 1/30/01

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle WA 98103
 RECEIVED BY: [Signature]
 DATE: 5/13/01 TIME: 12:00 INITIALS: RCIA
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature]
 DATE: _____

APPROVAL SIGNATURE (PROJECT MANAGER): _____

2104126

EDWARD K. NODA AND ASSOCIATES

CHAIN OF CUSTODY FORM

SHEET 14 OF 14

ASBESTOS BULK SAMPLE

BLDG. NAME & PROJECT NAME: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

SET	SAMPLE I.D. NO.	TYPE	FLOOR #	ROOM/AREA	MATERIAL DESCRIPTION
1	2197-855-131	B	Plenum	105 P1A	Joint Sealant on Fiberglass Pipe Insulation - 4" T - White
2	2197-855-132	B		105 P1A	- 4" Hanger -
3	2197-855-133	B		105 P1A	- 10" Run -
4	2197-855-134	B		120 P1A	- 3" Run -
5	2197-855-135	B		106 P1A	- 4" Elbow -
6	2197-855-136	B		135 P1A	- 10" Hanger -
7	2197-855-137	B	↓	139 P1A	↓ - 5" Elbow -
8	2197-855-138	B	Plenum	1A	White Sealant on HVAC Duct Insulation
9	2197-855-139	B	Plenum	1A	↓
10	2197-855-140	B	1	C1A	Brown Gypsum Board w/ Joint Compound

ANALYTICAL LABORATORY RESULTS

LAB I.D. NO.	CH	AM	CR	AC	AN	TR	COMMENTS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ADDITIONAL COMMENTS & NOTES: STOP ON FIRST POSITIVE FOR EACH SET, Fax daily results (808) 593-8551 Atn. Kenny Thomas

*SAMPLE TYPE CODES

- B = BULK MATERIAL
- D = DEBRIS SAMPLE
- SD/T = SURFACE DUST - TAPE SAMPLE
- SD/V = SURFACE DUST - VACUUM SAMPLE
- SD/G = SURFACE DUST - GRAB SAMPLE

ACCOUNTABILITY RECORD

REQUESTED COMPLETION DATE: 5 Day
 JOB NO.: 2197-01F BATCH NO. EKN01360
 CLIENT NAME: Will Choe / Corp of Engineers
 SAMPLER'S NAME: Bernard M. ... & Douglas Tisdell
 SIGNATURE: [Signature]
 DATE: 4/30/01 TIME COMPLETED: 12:30 DATE: 4/30/01
 DELIVERED TO LAB BY: FED-EX

LAB NAME: NVL Laboratories, Inc.
 ADDRESS: 4708 Aurora Avenue, Seattle, WA 98103
 RECEIVER BY: [Signature]
 DATE: 5/1/01 TIME: 10:00 AM
 ANALYZED BY: [Signature]
 LAB Q.C. APPROVAL: [Signature]
 DATE: 5/1/01

APPROVAL SIGNATURE (PROJECT MANAGER):

X

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051209

Client Sample #: 2197-855-001

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: Chrysotile

2%

LAYER 2: *None Detected

ND

Sample comments: Composite result for whole sample equals <1% Asbestos

Lab ID #: 21051210

Client Sample #: 2197-855-002

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051211

Client Sample #: 2197-855-003

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: White chalky material with paper

OTHER FIBROUS MATERIALS:

Cellulose 25%, Glass fibers 5%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

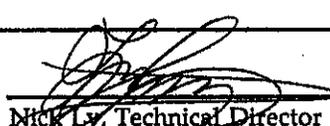
Sampled by: Client

Analyzed by: Wei Long Tai

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

*None Detected

ND

Lab ID #: 21051212

Client Sample #: 2197-855-004

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White powdery material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 25%, Glass fibers 7%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: Chrysotile

2%

LAYER 2: *None Detected

ND

Sample comments: Composite result for whole sample equals <1% Asbestos

Lab ID #: 21051213

Client Sample #: 2197-855-005

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White brittle material with paint, LAYER 2: White chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

(Sample results are continued on the next page.)

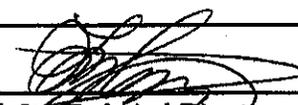
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051214

Client Sample #: 2197-855-006

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 20%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: Chrysotile

LAYER 2: *None Detected

PERCENT

2%

ND

Sample comments: Composite result for whole sample equals <1% Asbestos

Lab ID #: 21051215

Client Sample #: 2197-855-007

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 20%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE:

LAYER 1: Chrysotile

LAYER 2: *None Detected

PERCENT

2%

ND

Sample comments: Composite result for whole sample equals <1% Asbestos

(Sample results are continued on the next page.)

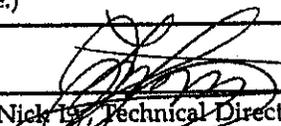
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01P

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051216 Client Sample #: 2197-855-008

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan powdery material with paint, LAYER 2: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%

LAYER 2: Cellulose 20%, Glass fibers 5%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT

LAYER 1: Chrysotile 2%

LAYER 2: *None Detected ND

Sample comments: Composite result for whole sample equals <1% Asbestos

Lab ID #: 21051217 Client Sample #: 2197-855-009

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Brown chalky material with paper

OTHER FIBROUS MATERIALS:

Cellulose 20%, Glass fibers 5%

NON-FIBROUS MATERIALS:

Binder & filler, Gypsum/binder

ASBESTOS TYPE: PERCENT

*None Detected ND

Lab ID #: 21051218 Client Sample #: 2197-855-010

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray sandy brittle material

OTHER FIBROUS MATERIALS:

Cellulose 3%

NON-FIBROUS MATERIALS:

Binder & filler, Granules

ASBESTOS TYPE: PERCENT

*None Detected ND

(Sample results are continued on the next page.)

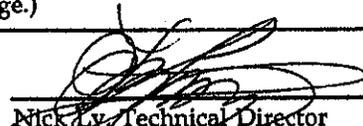
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051219 Client Sample #: 2197-855-011

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray sandy brittle material

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules

PERCENT

ND

Lab ID #: 21051220 Client Sample #: 2197-855-012

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray sandy brittle material

OTHER FIBROUS MATERIALS:

Cellulose 3%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Binder & filler, Granules

PERCENT

ND

Lab ID #: 21051221 Client Sample #: 2197-855-013

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Granules

PERCENT

ND

ND

(Sample results are continued on the next page.)

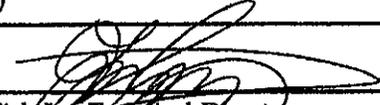
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936NVLAP
#102063**Bulk Asbestos Fiber Analysis**

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051222 Client Sample #: 2197-855-014

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Granules

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051223 Client Sample #: 2197-855-015

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Granules

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051224 Client Sample #: 2197-855-016

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Granules

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

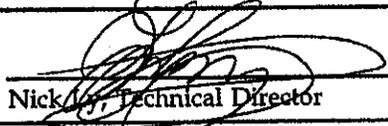
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21051225 Client Sample #: 2197-855-017

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Granules

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21051226 Client Sample #: 2197-855-018

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

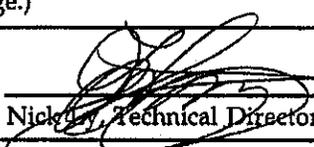
LAYER 1: Binder & filler, Paint
 LAYER 2: Binder & filler, Granules

ASBESTOS TYPE: PERCENT
 LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates

NVL Batch Number: 21-04070.00

Address: 615 Piko Street, Suite 300

Client Project #: 2197-01F

Honolulu, HI 96814

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051227

Client Sample #: 2197-855-019

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White brittle material with paint, LAYER 2: White sandy brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 2%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Paint

LAYER 2: Binder & filler, Granules

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051228

Client Sample #: 2197-855-020

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

ASBESTOS TYPE:**PERCENT**

Chrysotile

<1%

Lab ID #: 21051229

Client Sample #: 2197-855-021

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

ASBESTOS TYPE:**PERCENT**

Chrysotile

<1%

(Sample results are continued on the next page.)

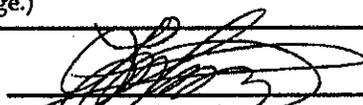
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051230 Client Sample #: 2197-855-022
 Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21051231 Client Sample #: 2197-855-023
 Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

PERCENT

<1%

Lab ID #: 21051232 Client Sample #: 2197-855-024
 Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray sandy brittle material with paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Binder & filler, Granules, Paint

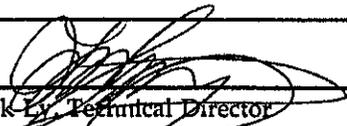
PERCENT

<1%

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051233 Client Sample #: 2197-855-025

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
 Cellulose 70%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler, Paint
PERCENT
 ND

Lab ID #: 21051234 Client Sample #: 2197-855-026

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
 Cellulose 70%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler, Paint
PERCENT
 ND

Lab ID #: 21051235 Client Sample #: 2197-855-027

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:
 Cellulose 70%

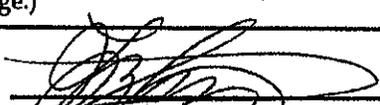
ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler, Paint
PERCENT
 ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936

Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051236 Client Sample #: 2197-855-028

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 70%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051237 Client Sample #: 2197-855-029

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 70%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051238 Client Sample #: 2197-855-030

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

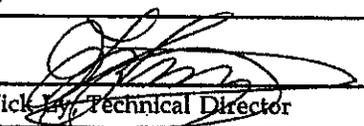
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051239 Client Sample #: 2197-855-031

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051240 Client Sample #: 2197-855-032

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Gray fibrous material with white paint

OTHER FIBROUS MATERIALS:

Cellulose 60%, Glass fibers 10%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051241 Client Sample #: 2197-855-033

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Brown flat rubbery material, LAYER 2: White mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

PERCENT

ND

ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

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Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051242 Client Sample #: 2197-855-034

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Brown flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21051243 Client Sample #: 2197-855-035

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Brown flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21051244 Client Sample #: 2197-855-036

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

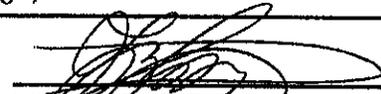
LAYER 1: Rubber/binder
 LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051245

Client Sample #: 2197-855-037

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051246

Client Sample #: 2197-855-038

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black flat rubbery material, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Rubber/binder

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

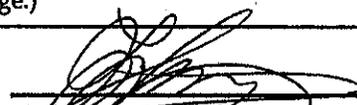
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Lab ID #: 21051247 Client Sample #: 2197-855-039

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl with brown streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051248 Client Sample #: 2197-855-040

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl with brown streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051249 Client Sample #: 2197-855-041

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl with brown streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

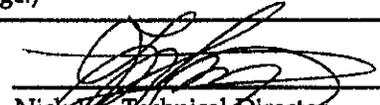
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051250

Client Sample #: 2197-855-042

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 4%
LAYER 3: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules
LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051251

Client Sample #: 2197-855-043

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 4%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

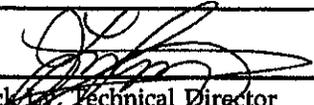
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051252

Client Sample #: 2197-855-044

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 4%
LAYER 3: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules
LAYER 3: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051253

Client Sample #: 2197-855-045

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Granules
LAYER 2: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051254

Client Sample #: 2197-855-046

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 2%
LAYER 2: Cellulose 3%**NON-FIBROUS MATERIALS:**LAYER 1: Vinyl/binder, Granules
LAYER 2: Mastic/binder

(Sample results are continued on the next page.)

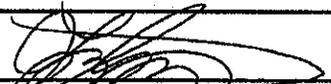
Sampled by: Client

Analyzed by: Wei Long Tai

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04070.00
 Client Project #: 2197-01F
 Number of samples: 50

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051255 Client Sample #: 2197-855-047

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White vinyl tile with black streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 3%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051256 Client Sample #: 2197-855-048

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Gray vinyl tile with white streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

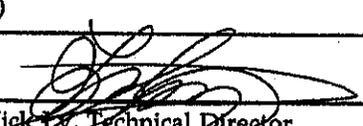
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04070.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051257

Client Sample #: 2197-855-049

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Gray vinyl tile with white streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051258

Client Sample #: 2197-855-050

Sample Location: Quad J - Bldg - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description:

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

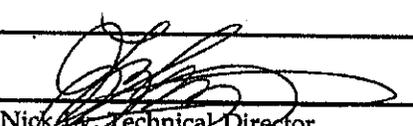
Sampled by: Client

Analyzed by: Wei Long Tai

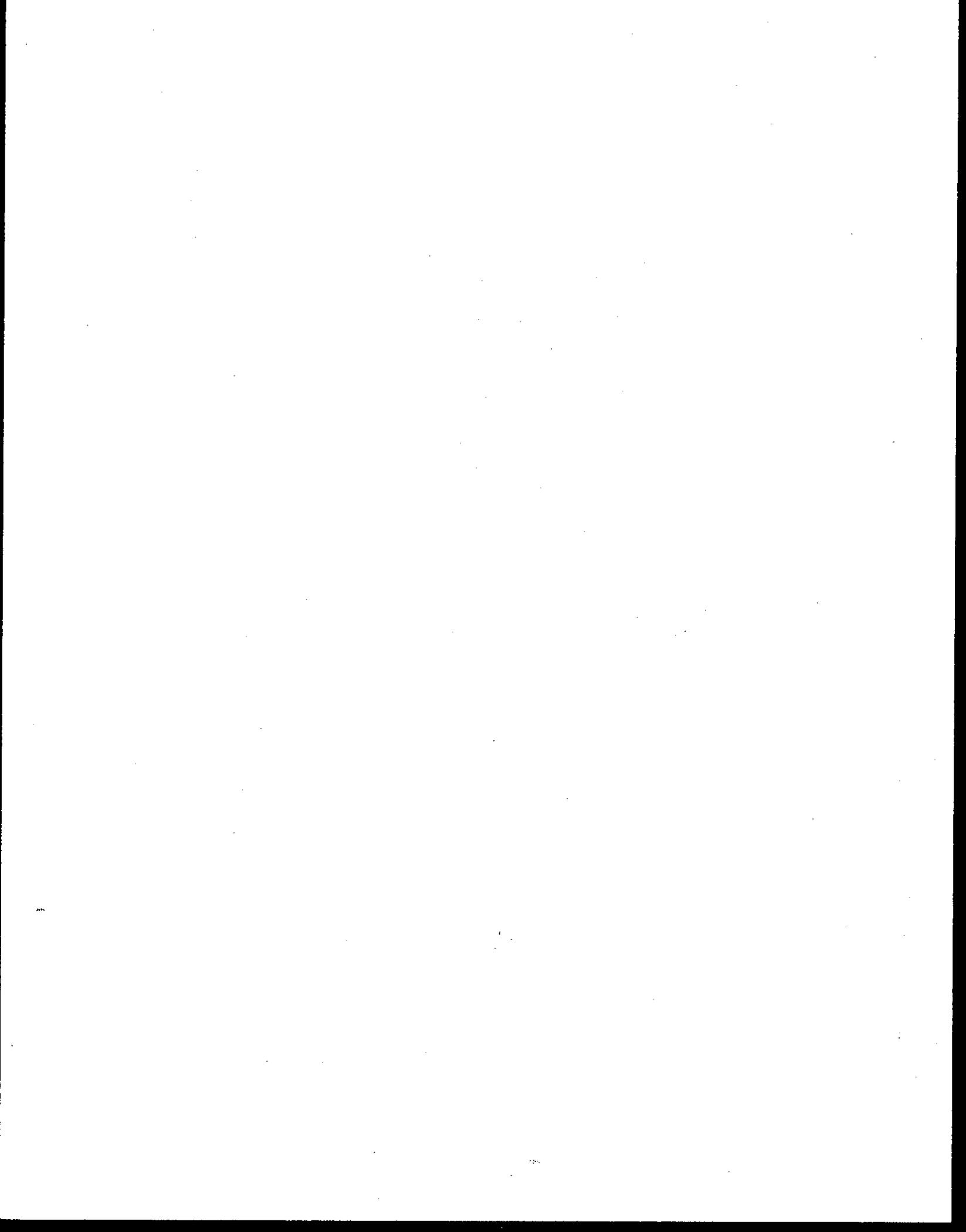
Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051620

Client Sample #: 2197-855-051

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Green vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 4%
LAYER 2: Cellulose 1%
LAYER 3: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules
LAYER 3: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051621

Client Sample #: 2197-855-052

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Green vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 4%
LAYER 2: Cellulose 1%
LAYER 3: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder, Granules
LAYER 3: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

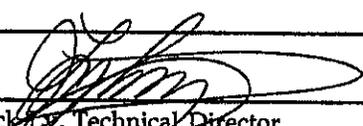
Sampled by: Client

Analyzed by: Wei Long Tai

Date: 05/14/2001

Reviewed by: Nick Ly

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda & Associates
 Address: 615 Pikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Lab ID #: 21051622 Client Sample #: 2197-855-053

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Green vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 1%
 LAYER 3: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder
 LAYER 2: Vinyl/binder, Granules
 LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051623 Client Sample #: 2197-855-054

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Beige vinyl tile with Gray streaks, LAYER 2: Gray mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051624 Client Sample #: 2197-855-055

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Beige vinyl tile with Gray streaks, LAYER 2: Gray mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

(Sample results are continued on the next page.)

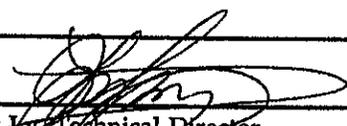
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051625 Client Sample #: 2197-855-056

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Beige vinyl tile with Gray streaks, LAYER 2: Gray mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051626 Client Sample #: 2197-855-057

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl tile with Green streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

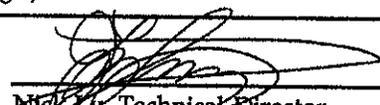
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04117.00
 Client Project #: 2197-01F
 Number of samples: 30

Lab ID #: 21051627 Client Sample #: 2197-855-058

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White vinyl tile with Green streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051628 Client Sample #: 2197-855-059

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: White vinyl tile with Green streaks, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 1%
 LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules
 LAYER 2: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051629 Client Sample #: 2197-855-060

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Yellow mastic, LAYER 2: White vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 4%
 LAYER 2: Cellulose 1%
 LAYER 3: Cellulose 5%

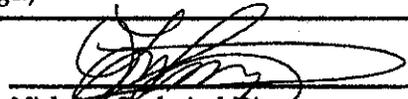
NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder
 LAYER 2: Vinyl/binder, Granules
 LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
(Sample results are continued on the next page.)	

Sampled by: Client
 Analyzed by: Wei Long Tai
 Reviewed by: Nick Ly

Date: 05/14/2001
 Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

LAYER 1:	*None Detected	ND
LAYER 2:	*None Detected	ND
LAYER 3:	*None Detected	ND

Lab ID #: 21051630

Client Sample #: 2197-855-061

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: White brittle material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%

LAYER 2: Cellulose 4%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051631

Client Sample #: 2197-855-062

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White vinyl tile, LAYER 2: Yellow mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 2%

LAYER 2: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder, Granules

LAYER 2: Mastic/binder

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Lab ID #: 21051632 Client Sample #: 2197-855-063

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%
 LAYER 3: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder
 LAYER 2: Vinyl/binder
 LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051633 Client Sample #: 2197-855-064

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 4%
 LAYER 3: Cellulose 5%

NON-FIBROUS MATERIALS:

LAYER 1: Mastic/binder
 LAYER 2: Vinyl/binder
 LAYER 3: Mastic/binder

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

(Sample results are continued on the next page.)

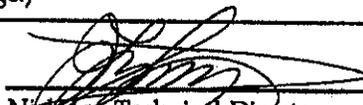
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

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NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051634

Client Sample #: 2197-855-065

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Yellow mastic, LAYER 2: Brown vinyl tile, LAYER 3: Black mastic

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 4%
LAYER 3: Cellulose 5%**NON-FIBROUS MATERIALS:**LAYER 1: Mastic/binder
LAYER 2: Vinyl/binder
LAYER 3: Mastic/binder**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: Chrysotile	3%

Lab ID #: 21051635

Client Sample #: 2197-855-066

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 30%, Glass fibers 17%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

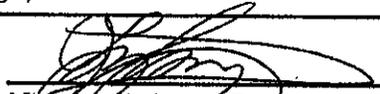
Sampled by: Client

Analyzed by: Wei Long Tai

Date: 05/14/2001

Reviewed by: Nick Ly

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda & Associates
Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051636

Client Sample #: 2197-855-067

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 30%, Glass fibers 17%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21051637

Client Sample #: 2197-855-068

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 3%
LAYER 2: Cellulose 30%, Glass fibers 17%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP
#102063

Client: Edward K. Noda & Associates
Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051638

Client Sample #: 2197-855-069

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material with white fibrous material and mastic and silver paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 17%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE:

PERCENT

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051639

Client Sample #: 2197-855-070

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material with white fibrous material and mastic and silver paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 17%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE:

PERCENT

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051640

Client Sample #: 2197-855-071

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White soft material with white fibrous material and mastic and silver paper, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 17%

LAYER 2: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler, Mastic/binder

LAYER 2: Binder & filler

ASBESTOS TYPE:

PERCENT

(Sample results are continued on the next page.)

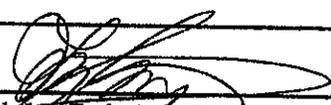
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


Nick Ly, Technical Director

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#102063

Client: Edward K. Noda & Associates
 Address: 615 Piko Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04117.00
 Client Project #: 2197-01F
 Number of samples: 30

LAYER 1: *None Detected ND
 LAYER 2: *None Detected ND

Lab ID #: 21051641 Client Sample #: 2197-855-072

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray brittle material

OTHER FIBROUS MATERIALS:
 Cellulose 25%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler

PERCENT
 ND

Lab ID #: 21051642 Client Sample #: 2197-855-073

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray brittle material

OTHER FIBROUS MATERIALS:
 Cellulose 25%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler
PERCENT
 ND

Lab ID #: 21051643 Client Sample #: 2197-855-074

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Gray brittle material

OTHER FIBROUS MATERIALS:
 Cellulose 25%

ASBESTOS TYPE:
 *None Detected

NON-FIBROUS MATERIALS:
 Binder & filler
PERCENT
 ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Bulk Asbestos Fiber Analysis

NVLAP

#102063

Client: Edward K. Noda & Associates

Address: 615 Pikoi Street, Suite 300

Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Lab ID #: 21051644

Client Sample #: 2197-855-075

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black soft material with white woven fibrous material and paint

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 25%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051645

Client Sample #: 2197-855-076

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black soft material with white woven fibrous material and paint

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 25%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

Lab ID #: 21051646

Client Sample #: 2197-855-077

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black soft material with white woven fibrous material and paint

OTHER FIBROUS MATERIALS:

Cellulose 4%, Glass fibers 25%

NON-FIBROUS MATERIALS:

Binder & filler, Paint

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

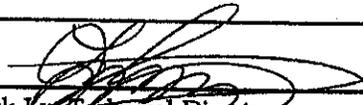
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

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Address: 615 Piko Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051647

Client Sample #: 2197-855-078

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Wollastonite 7%
LAYER 2: Cellulose 30%, Glass fibers 17%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21051648

Client Sample #: 2197-855-079

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Wollastonite 7%
LAYER 2: Cellulose 30%, Glass fibers 17%
LAYER 3: Glass fibers 80%**NON-FIBROUS MATERIALS:**LAYER 1: Binder & filler
LAYER 2: Binder & filler, Mastic/binder
LAYER 3: Binder & filler**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

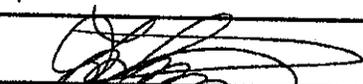
Sampled by: Client

Analyzed by: Wei Long Tai

Reviewed by: Nick Ly

Date: 05/14/2001

Date: 05/14/2001


 Nick Ly, Technical Director

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Address: 615 Pikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04117.00

Client Project #: 2197-01F

Number of samples: 30

Attn.: Mr. William Harris

Project: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051649

Client Sample #: 2197-855-080

Sample Location: Quad J-Bldg-855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Tan soft material, LAYER 2: Silver paper with tan/white fibrous material and mastic, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Wollastonite 7%

LAYER 2: Cellulose 30%, Glass fibers 17%

LAYER 3: Glass fibers 80%

NON-FIBROUS MATERIALS:

LAYER 1: Binder & filler

LAYER 2: Binder & filler, Mastic/binder

LAYER 3: Binder & filler

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

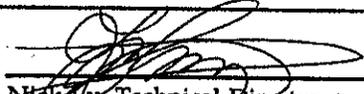
Sampled by: Client

Analyzed by: Wei Long Tai

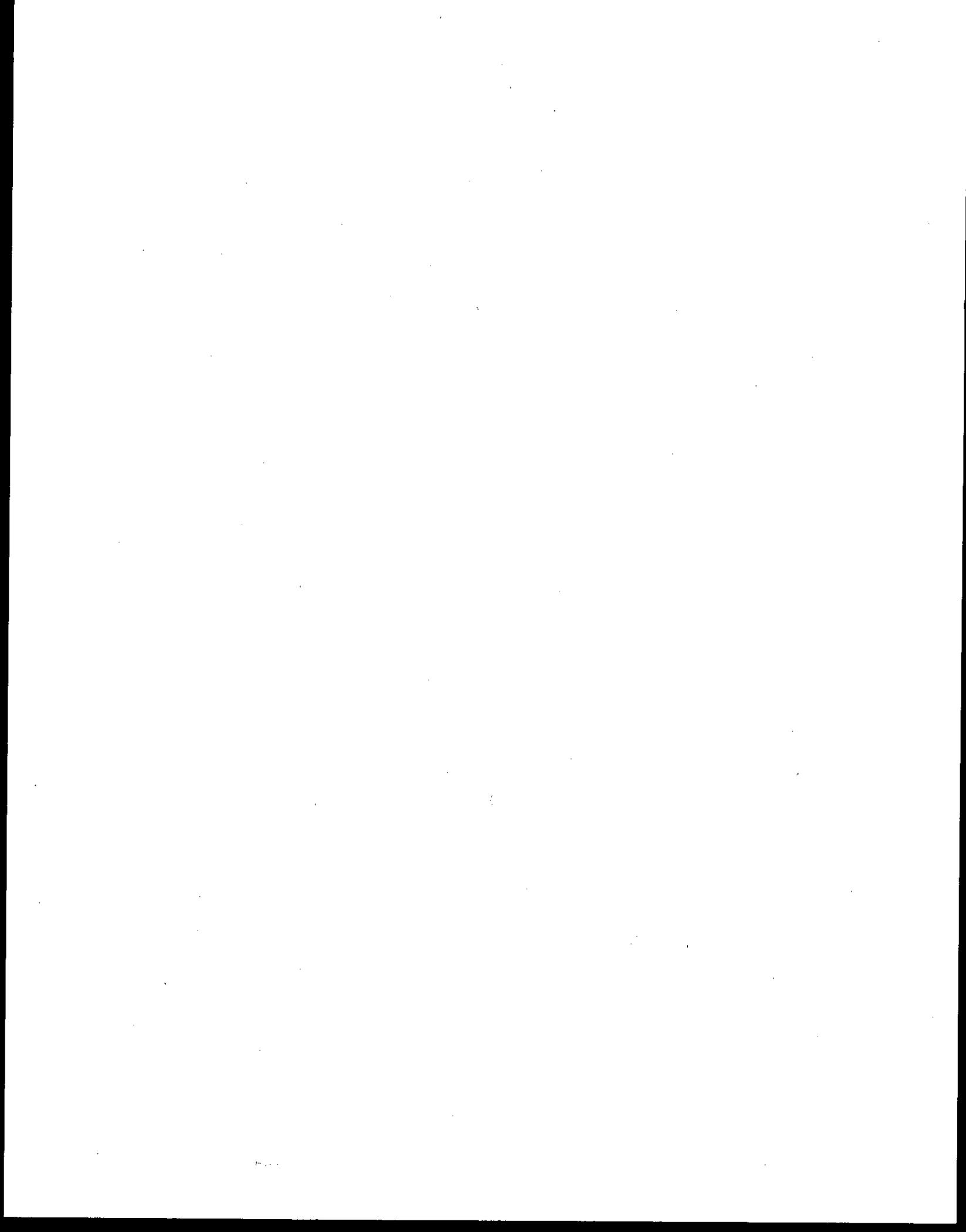
Date: 05/14/2001

Reviewed by: Nick Ly

Date: 05/14/2001


Nick Ly, Technical Director

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051674

Client Sample #: 2197-855-081

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Silver paint with white woven fiber, mastic and metal foil LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Wollastonite 5%, Cellulose 4%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Paint, Metal foil, Fine particles,
Mastic/binder
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051675

Client Sample #: 2197-855-082

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Silver paint with white woven fiber, mastic and metal foil LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Wollastonite 5%, Cellulose 4%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Paint, Metal foil, Fine particles,
Mastic/binder
LAYER 2: Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

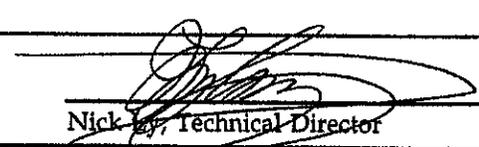
Sampled by: Client

Analyzed by: Steve Zhang

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

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Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Lab ID #: 21051676 Client Sample #: 2197-855-083

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Silver paint with white woven fiber, mastic and metal foil LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Wollastonite 5%, Cellulose 4%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Paint, Metal foil, Fine particles,
Mastic/binder
LAYER 2: Fine particles**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051677 Client Sample #: 2197-855-084

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Metal foil with brown fibrous material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: Wollastonite 5%, Cellulose 4%
LAYER 2: Glass fibers 75%**NON-FIBROUS MATERIALS:**LAYER 1: Metal foil, Fine particles
LAYER 2: Fine particles**ASBESTOS TYPE: PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051678 Client Sample #: 2197-855-085

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Brown/white fibrous material with powdery material and metal

OTHER FIBROUS MATERIALS:

Glass fibers 65%

NON-FIBROUS MATERIALS:

Fine particles, Metal

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

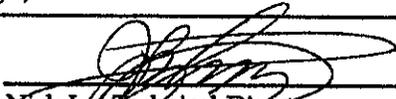
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

None Detected*ND**

Lab ID #: 21051679

Client Sample #: 2197-855-086

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Metal foil with brown fibrous material LAYER 2: Brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Wollastonite 5%, Cellulose 4%

LAYER 2: Glass fibers 75%

NON-FIBROUS MATERIALS:

LAYER 1: Metal foil, Fine particles

LAYER 2: Fine particles

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051680

Client Sample #: 2197-855-087

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 25%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder

LAYER 2: Calcareous matrix, Perlite

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051681

Client Sample #: 2197-855-088

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 25%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder

LAYER 2: Calcareous matrix, Perlite

(Sample results are continued on the next page.)

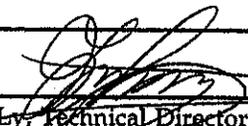
Sampled by: Client

Analyzed by: Steve Zhang

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051682 Client Sample #: 2197-855-089

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 25%
LAYER 2: Cellulose 55%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder
LAYER 2: Calcareous matrix, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051683 Client Sample #: 2197-855-090

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 15%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21051684 Client Sample #: 2197-855-091

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 15%

NON-FIBROUS MATERIALS:

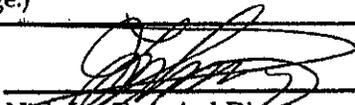
Asphalt/binder, Mineral/binder

(Sample results are continued on the next page.)

Sampled by: Client
Analyzed by: Steve Zhang
Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063

Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00
 Client Project #: 2197-01F
 Number of samples: 50

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21051685 Client Sample #: 2197-855-092
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:
 Cellulose 15%

NON-FIBROUS MATERIALS:
 Asphalt/binder, Mineral/binder

ASBESTOS TYPE:	PERCENT
*None Detected	ND

Lab ID #: 21051686 Client Sample #: 2197-855-093
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 5%, Glass fibers 15%
 LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:
 LAYER 1: Asphalt/binder, Mineral/binder
 LAYER 2: Calcareous matrix, Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051687 Client Sample #: 2197-855-094
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:
 LAYER 1: Cellulose 5%, Glass fibers 15%
 LAYER 2: Cellulose 55%

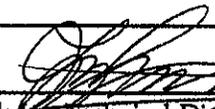
NON-FIBROUS MATERIALS:
 LAYER 1: Asphalt/binder, Mineral/binder
 LAYER 2: Calcareous matrix, Fine particles

ASBESTOS TYPE:	PERCENT
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(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051688

Client Sample #: 2197-855-095

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder, Mineral/binder

LAYER 2: Calcareous matrix, Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051689

Client Sample #: 2197-855-096

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder, Mineral/binder

LAYER 2: Calcareous matrix, Fine particles

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

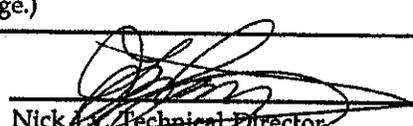
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051690

Client Sample #: 2197-855-097

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 15%
LAYER 2: Cellulose 55%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Mineral/binder
LAYER 2: Calcareous matrix, Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051691

Client Sample #: 2197-855-098

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 15%
LAYER 2: Cellulose 55%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder, Mineral/binder
LAYER 2: Calcareous matrix, Fine particles**ASBESTOS TYPE:****PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

Lab ID #: 21051692

Client Sample #: 2197-855-099

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 5%

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

ASBESTOS TYPE:**PERCENT**

*None Detected

ND

(Sample results are continued on the next page.)

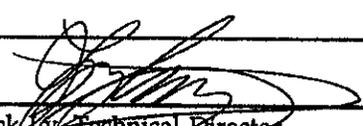
Sampled by: Client

Analyzed by: Steve Zhang

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Client: Edward K. Noda and Associates
 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051693 Client Sample #: 2197-855-100
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

PERCENT

ND

Lab ID #: 21051694 Client Sample #: 2197-855-101
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Black asphaltic material with mineral grains

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Asphalt/binder, Mineral/binder

PERCENT

ND

Lab ID #: 21051695 Client Sample #: 2197-855-102
 Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%
 LAYER 2: Cellulose 55%

ASBESTOS TYPE:

LAYER 1: *None Detected

LAYER 2: *None Detected

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder
 LAYER 2: Fine particles, Perlite

PERCENT

ND

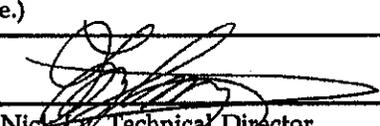
ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051696 Client Sample #: 2197-855-103

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder

LAYER 2: Fine particles, Perlite

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051697 Client Sample #: 2197-855-104

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder

LAYER 2: Fine particles, Perlite

ASBESTOS TYPE: PERCENT

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

Lab ID #: 21051698 Client Sample #: 2197-855-105

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%

LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder

LAYER 2: Fine particles, Perlite

ASBESTOS TYPE: PERCENT

(Sample results are continued on the next page.)

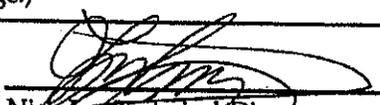
Sampled by: Client

Analyzed by: Steve Zhang

Date: 05/11/2001

Reviewed by: Nick Ly

Date: 05/11/2001


Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051699 Client Sample #: 2197-855-106

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 15%
LAYER 2: Cellulose 55%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder
LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051700 Client Sample #: 2197-855-107

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:LAYER 1: Cellulose 5%, Glass fibers 15%
LAYER 2: Cellulose 55%**NON-FIBROUS MATERIALS:**LAYER 1: Asphalt/binder
LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051701 Client Sample #: 2197-855-108

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%
 LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder
 LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051702 Client Sample #: 2197-855-109

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Black asphaltic material LAYER 2: Grey fibrous and porous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 5%, Glass fibers 15%
 LAYER 2: Cellulose 55%

NON-FIBROUS MATERIALS:

LAYER 1: Asphalt/binder
 LAYER 2: Fine particles, Perlite

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND

Lab ID #: 21051703 Client Sample #: 2197-855-110

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Grey surfaced black asphaltic material with sands

OTHER FIBROUS MATERIALS:

Cellulose 5%

NON-FIBROUS MATERIALS:

Asphalt/binder

ASBESTOS TYPE:	PERCENT
Chrysotile	5%

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 05/11/2001
 Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00
 Client Project #: 2197-01F
 Number of samples: 50

Lab ID #: 21051704 Client Sample #: 2197-855-111

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051705 Client Sample #: 2197-855-112

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051706 Client Sample #: 2197-855-113

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii
 Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material with grey tape and brown fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%
 LAYER 2: Cellulose 25%

NON-FIBROUS MATERIALS:

LAYER 1: Paint
 LAYER 2: Asphalt/binder

ASBESTOS TYPE:

LAYER 1: Chrysotile

LAYER 2: Chrysotile

PERCENT

2%

2%

(Sample results are continued on the next page.)

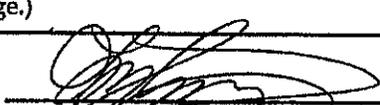
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Lab ID #: 21051707

Client Sample #: 2197-855-114

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051708

Client Sample #: 2197-855-115

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051709

Client Sample #: 2197-855-116

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black asphaltic material with silver paint and sands

OTHER FIBROUS MATERIALS:

Cellulose 5%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Asphalt/binder, Paint, Sands

PERCENT

2%

Sample comments: Asbestos found in paint and its vicinity

(Sample results are continued on the next page.)

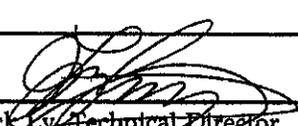
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051710 Client Sample #: 2197-855-117

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051711 Client Sample #: 2197-855-118

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051712 Client Sample #: 2197-855-119

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Silver paint LAYER 2: Black asphaltic material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Glass fibers 4%

NON-FIBROUS MATERIALS:

LAYER 1: Paint

LAYER 2: Asphalt/binder

ASBESTOS TYPE:

LAYER 1: Chrysotile

LAYER 2: Chrysotile

PERCENT

3%

2%

(Sample results are continued on the next page.)

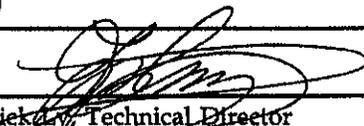
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Lab ID #: 21051713 Client Sample #: 2197-855-120

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051714 Client Sample #: 2197-855-121

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051715 Client Sample #: 2197-855-122

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Silver paint

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

Chrysotile

NON-FIBROUS MATERIALS:

Paint

PERCENT

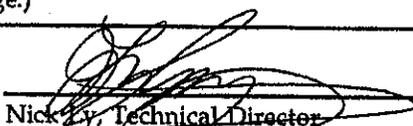
4%

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Steve Zhang
 Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051716 Client Sample #: 2197-855-123

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051717 Client Sample #: 2197-855-124

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051718 Client Sample #: 2197-855-125

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black rubbery material with mastic

OTHER FIBROUS MATERIALS:

Cellulose 2%

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

ASBESTOS TYPE:

*None Detected

PERCENT

ND

(Sample results are continued on the next page.)

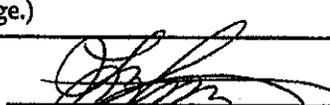
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Attn.: Mr. William Harris

Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051719

Client Sample #: 2197-855-126

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black rubbery material

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

PERCENT

ND

Lab ID #: 21051720

Client Sample #: 2197-855-127

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Black rubbery material

OTHER FIBROUS MATERIALS:

Cellulose 2%

ASBESTOS TYPE:

*None Detected

NON-FIBROUS MATERIALS:

Rubber/binder, Mastic/binder

PERCENT

ND

Lab ID #: 21051721

Client Sample #: 2197-855-128

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Green tile LAYER 2: Black asphaltic mastic

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 3%

LAYER 2: Cellulose 4%

ASBESTOS TYPE:

LAYER 1: Chrysotile

LAYER 2: Chrysotile

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous matrix

LAYER 2: Asphalt/binder

PERCENT

2%

3%

(Sample results are continued on the next page.)

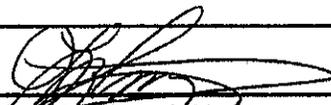
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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 Honolulu, HI 96814
 Attn.: Mr. William Harris
 Project: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04121.00

Client Project #: 2197-01F

Number of samples: 50

Lab ID #: 21051722 Client Sample #: 2197-855-129

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

Lab ID #: 21051723 Client Sample #: 2197-855-130

Sample Location: Quad J - Bldg. - 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: Sample not analyzed

OTHER FIBROUS MATERIALS:

Sample not analyzed

NON-FIBROUS MATERIALS:

Sample not analyzed

ASBESTOS TYPE:

Sample not analyzed

PERCENT

ND

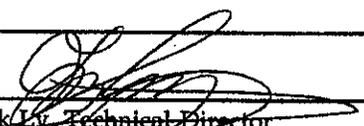
Sampled by: Client

Analyzed by: Steve Zhang

Reviewed by: Nick Ly

Date: 05/11/2001

Date: 05/11/2001


 Nick Ly, Technical Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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Fax: 206.634.1936**Bulk Asbestos Fiber Analysis**NVLAP
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04126.00

Client Project #: 2197-01F

Number of samples: 10

Attn.: Mr. Will Harris

Project: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051749

Client Sample #: 2197-855-131

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 40%, Glass fiber 10%
LAYER 3: Glass fiber 95%**NON-FIBROUS MATERIALS:**LAYER 1: Fine particles, Paint/coating
LAYER 2: Metal foil, Adhesive/binder
LAYER 3: Resin

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Lab ID #: 21051750

Client Sample #: 2197-855-132

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Clear rubbery sealant, LAYER 2: Foil-backed white felt, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:LAYER 1: *None Detected
LAYER 2: Cellulose 40%, Glass fiber 10%
LAYER 3: Glass fiber 95%**NON-FIBROUS MATERIALS:**LAYER 1: Adhesive/binder
LAYER 2: Metal foil, Adhesive/binder
LAYER 3: Resin

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

Sampled by: Client

Analyzed by: Carol Evans

Reviewed by: Munaf Khan

Date: 05/11/2001

Date: 05/11/2001


 Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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#102063

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Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04126.00

Client Project #: 2197-01F

Number of samples: 10

Attn.: Mr. Will Harris

Project: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051751

Client Sample #: 2197-855-133

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 40%, Glass fiber 10%

LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Paint/coating

LAYER 2: Metal foil, Adhesive/binder

LAYER 3: Resin

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

Lab ID #: 21051752

Client Sample #: 2197-855-134

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Multiple layers of foil-backed felt, LAYER 2: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: Cellulose 40%, Glass fiber 10%

LAYER 2: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Adhesive/binder, Metal foil

LAYER 2: Resin

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

(Sample results are continued on the next page.)

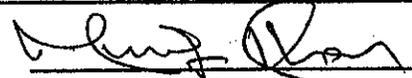
Sampled by: Client

Analyzed by: Carol Evans

Reviewed by: Munaf Khan

Date: 05/11/2001

Date: 05/11/2001


 Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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 Address: 615 Piikoi Street, Suite 300
 Honolulu, HI 96814
 Attn.: Mr. Will Harris
 Project: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

NVL Batch Number: 21-04126.00
 Client Project #: 2197-01F
 Number of samples: 10

Lab ID #: 21051753 Client Sample #: 2197-855-135

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: Smooth white plastic, LAYER 2: Rough off-white coating, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: *None Detected
 LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Vinyl/binder
 LAYER 2: Fine particles, Paint/coating
 LAYER 3: Resin

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: Chrysotile	3%
LAYER 3: *None Detected	ND

Lab ID #: 21051754 Client Sample #: 2197-855-136

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected
 LAYER 2: Cellulose 40%, Glass fiber 10%
 LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Paint/coating
 LAYER 2: Metal foil, Adhesive/binder
 LAYER 3: Resin

ASBESTOS TYPE:	PERCENT
LAYER 1: *None Detected	ND
LAYER 2: *None Detected	ND
LAYER 3: *None Detected	ND

(Sample results are continued on the next page.)

Sampled by: Client
 Analyzed by: Carol Evans
 Reviewed by: Munaf Khan

Date: 05/11/2001
 Date: 05/11/2001


 Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=5-15%, 20%=10-30%, 50%=40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

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NVL Batch Number: 21-04126.00

Client Project #: 2197-01F

Number of samples: 10

Attn.: Mr. Will Harris

Project: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051755

Client Sample #: 2197-855-137

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Yellow fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 40%, Glass fiber 10%

LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Paint/coating

LAYER 2: Metal foil, Adhesive/binder

LAYER 3: Resin

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

LAYER 3: *None Detected ND

Lab ID #: 21051756

Client Sample #: 2197-855-138

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 40%, Glass fiber 10%

LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Paint/coating

LAYER 2: Metal foil, Adhesive/binder

LAYER 3: Resin

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected ND

LAYER 2: *None Detected ND

LAYER 3: *None Detected ND

(Sample results are continued on the next page.)

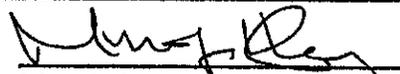
Sampled by: Client

Analyzed by: Carol Evans

Reviewed by: Munaf Khan

Date: 05/11/2001

Date: 05/11/2001


 Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and acuity of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

NVL Laboratories, Inc.

4708 Aurora Ave. N., Seattle, WA 98103

Tel: 206.547.0100
Fax: 206.634.1936**Bulk Asbestos Fiber Analysis****NVLAP**
#102063Client: Edward K. Noda and Associates
Address: 615 Piikoi Street, Suite 300
Honolulu, HI 96814

NVL Batch Number: 21-04126.00

Client Project #: 2197-01F

Number of samples: 10

Attn.: Mr. Will Harris

Project: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Lab ID #: 21051757

Client Sample #: 2197-855-139

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White rubbery sealant, LAYER 2: Multiple layers of foil-backed felt, LAYER 3: Pink fibrous material

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 40%, Glass fiber 10%

LAYER 3: Glass fiber 95%

NON-FIBROUS MATERIALS:

LAYER 1: Fine particles, Paint/coating

LAYER 2: Metal foil, Adhesive/binder

LAYER 3: Resin

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

LAYER 3: *None Detected

ND

Lab ID #: 21051758

Client Sample #: 2197-855-140

Sample Location: Quad J - Bldg 855, DIVARTY Dining Facility, Schofield Barracks, Hawaii

Description: LAYER 1: White crumbly compound, LAYER 2: Light brown chalky material with brown felt

OTHER FIBROUS MATERIALS:

LAYER 1: *None Detected

LAYER 2: Cellulose 10%, Glass fiber <1%

NON-FIBROUS MATERIALS:

LAYER 1: Calcareous filler/binder, Mica

LAYER 2: Gypsum/binder

ASBESTOS TYPE:**PERCENT**

LAYER 1: *None Detected

ND

LAYER 2: *None Detected

ND

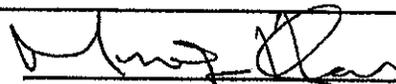
Sampled by: Client

Analyzed by: Carol Evans

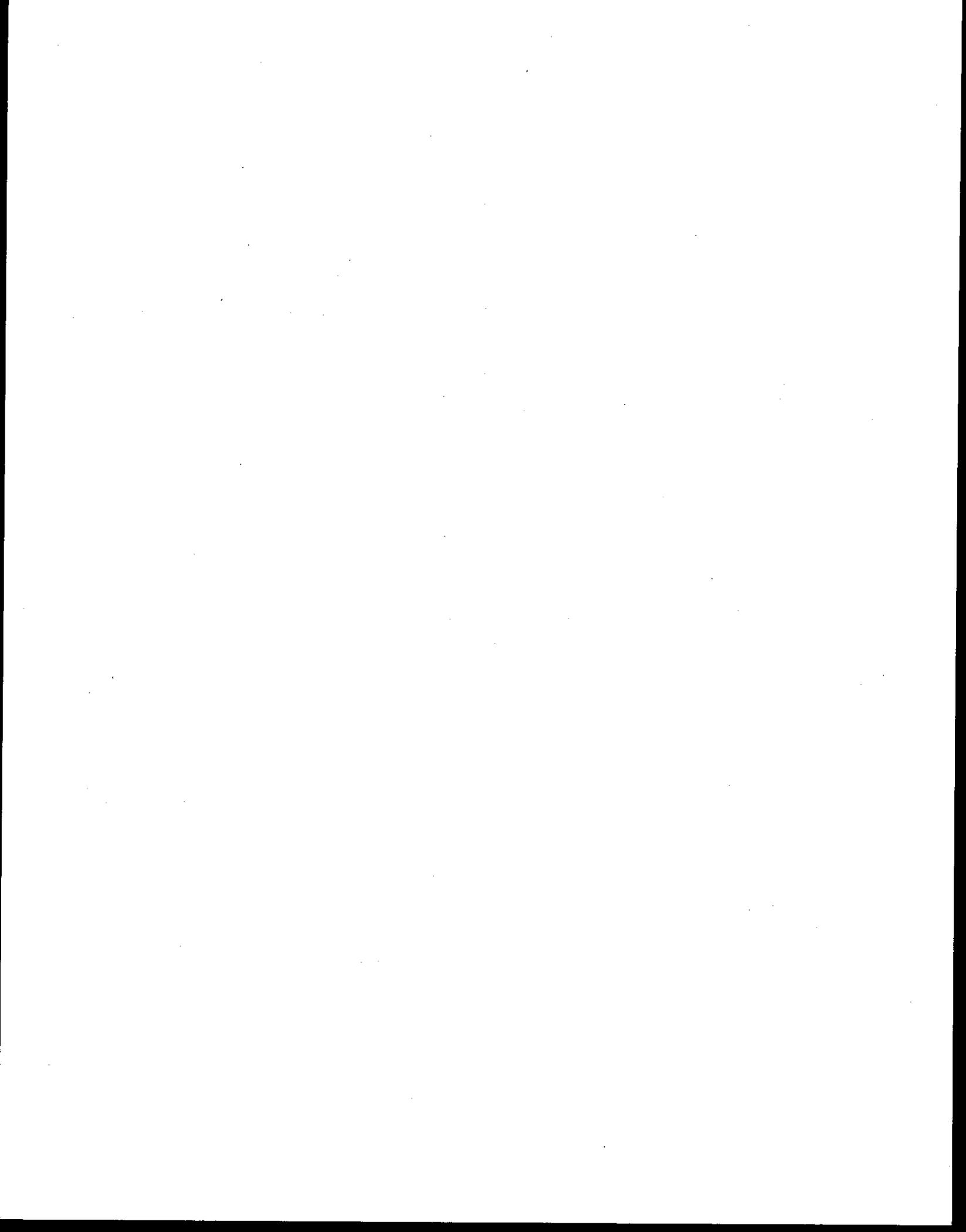
Reviewed by: Munaf Khan

Date: 05/11/2001

Date: 05/11/2001


 Munaf Khan, Laboratory Director

Note: If samples are not homogeneous, then subsamples of the components were analyzed separately. All bulk samples are analyzed using EPA 600/R-93/116 Method with the following measurement uncertainties for the reported % Asbestos (1%=>0-3%, 5%=>1-9%, 10%=>5-15%, 20%=>10-30%, 50%=>40-60%). This report relates only to the items tested. If samples were not collected by NVL personnel, then the accuracy of the results is limited by the methodology and aculty of the sample collector. This report shall not be reproduced except in full, without written approval of NVL Laboratories, Inc. It shall not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.



APPENDIX C
INSPECTOR CERTIFICATES

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii



MURANAKA ENVIRONMENTAL CONSULTANTS, INC.

Training Certificate

This is to certify that

WILLIAM HARRIS

has attended the

AHERA Inspector/Management Planner

Refresher Course

Accredited Under TSECA Title II

Certificate number: IAVII-MEC-AIMPR-080995-01

August 5, 1999

Date of Attendance

August 5, 2000

Expiration Date

Training Provider:
Muranaka Environmental Consultants, Inc.
500 Ala Kawa Street, Building 220, 2nd Floor
Honolulu, Hawaii 96817

Phone: (808) 848-8866

Fax: (808) 847-5267

Mark T. Muranaka, M.S., M.P.H.

President



Brewer Environmental Services

Training Certificate

This is to certify that

STEVEN K. CHUN

has attended the

**AHERA Inspector Refresher Course
Accredited Under TSCA Title II**

Certificate number: IAVII-MEC-AIR-101095-15

August 4, 2000

Date of Attendance

August 4, 2001

Expiration Date

Training Provider:

BES IH Group

500 Ala Kawa Street, Building 220, 2nd Floor

Honolulu, Hawaii 96817

Phone: (808) 848-8866

Fax: (808) 847-5267

Mark T. Muranaka, M.S., M.P.H.

Director, IH Group



Globeteck Group Inc.

544 Ohohia Street, Suite 2, Honolulu, Hawaii 96819, Phone: (808) 833-5787, Fax: (808) 833-5789

is pleased to announce that

Kennyson K. Thomas

576-80-1848

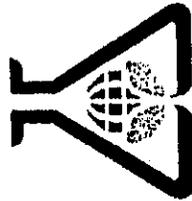
has attended and successfully completed, in accordance with the Asbestos Hazard Emergency Response Act (40 CFR 763), Asbestos Building Inspector Refresher Training Course as prescribed by the United States Environmental Protection Agency (EPA) under Title II of the Toxic Substances Control Act (TSCA) and has passed an examination in that course with at least a minimum score of 70%. This training course is accredited by the State of South Dakota Environmental and Natural Resources Division.

AHERA Asbestos Building Inspector Refresher Training Certificate

Certificate Number: GGI-ABIR010102-02T
Place of Training: Honolulu, Hawaii
Date of Course: January 2, 2001
Date of Examination: January 2, 2001
Date of Expiration: January 2, 2002



MOHAMMAD ROFIQ, MPH, CHMM
Training Director
Honolulu, Hawaii



Brewer Environmental Services

Training Certificate

This is to certify that

DOUGLAS G. TISDELL

has attended the

AHERA Inspector/Management Planner Refresher Course
Accredited Under ISSCA Title II.

Certificate number: IAVII-BES-AIR-090800-16

September 8, 2000

Date of Attendance

September 8, 2001

Expiration Date

Training Provider:

BES IH Group

500 Ala Kawa Street, Building 220, 2nd Floor
Honolulu, Hawaii 96817

Phone: (808) 848-8866

Fax: (808) 847-5267

Mark T. Muranaka, M.S., M.P.H.

Director, IH Group



Globetech Group Inc.

544 Ohohia Street, Suite 2, Honolulu, Hawaii 96819, (808) 833-5787, Fax: (808) 833-5787

is pleased to announce that

Christina Arouh

312-86-4211

has attended and successfully completed, in accordance with the Asbestos Hazard Emergency Response Act (40 CFR 763), Asbestos Building Inspector Initial Training Course as prescribed by the United States Environmental Protection Agency (EPA) under Title II of the Toxic Substances Control Act (TSCA) and has passed an examination in that course with at least a minimum score of 70%. This training course is accredited by the State of South Dakota Environmental and Natural Resources Division.

AHERA Asbestos Building Inspector Initial Training Certificate

Certificate Number: GGL-ABII1206-01A
Place of Training: Honolulu, Hawaii
Date of Course: December 4-6, 2000
Date of Examination: December 6, 2000
Date of Expiration: December 6, 2001



MOHAMMAD ROUF, MPH, CHMM
Training Director
Honolulu, Hawaii

Certificate of Completion

This is to certify that
Prudy Stoudt-McRae
has satisfactorily completed
4 hours of refresher training as an

Asbestos Building Inspector

to comply with the training requirements of
OSHA Title 29 / 40 CFR 763 (ABEBA)

Certificate Number 996359

Phyllis Murphy
Training Administrator

AHERA Certified: MO9907012

ARGUS
PACIFIC
SAFETY • TRAINING • INDUSTRIAL HYGIENE

Oct 25, 2000

Date(s) of Training

Expiration Date: Oct 25, 2001

Argus Pacific, Inc. • 1900 W. Nickerson, Suite 315 • Seattle, Washington • 98119 • (206) 285-3373 • fax (206) 285-3927

APPENDIX D

LABORATORY CERTIFICATES

Volume III
Final Asbestos Survey, Analysis and Report for:
Quad J - Buildings 847 and 855 "DIVARTY" Dining Facility, Schofield Barracks, Oahu, Hawaii

National Institute
of Standards and Technology



National Voluntary
Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation



Page: 1 of 1

BULK ASBESTOS FIBER ANALYSIS

NVLAP LAB CODE 102063-0

NVL LABORATORIES, INC.

4708 Aurora Avenue N.

Seattle, WA 98103

Mr. Nghiep Vi Ly

Phone: 206-547-0100 Fax: 206-634-1936

E-Mail: munaf@nvlabs.com

URL: <http://www.nvlabs.com>

NVLAP Code

Designation

18/A01

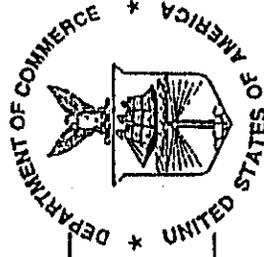
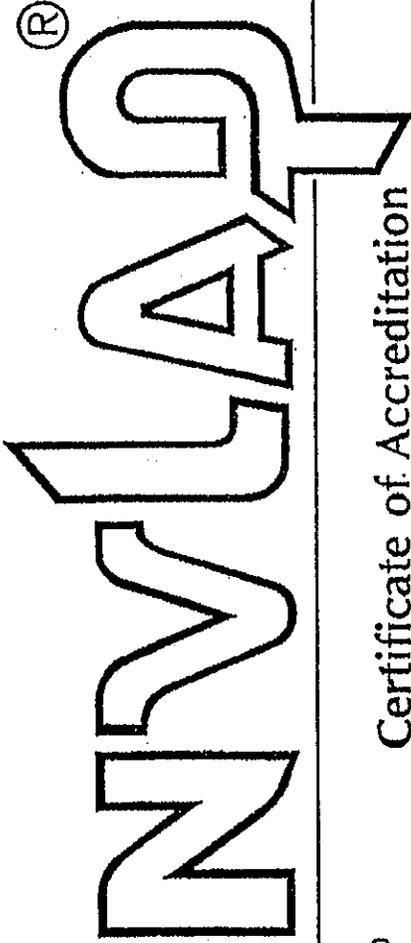
EPA-600/M4-82-020: Interim Method for the Determination of Asbestos in Bulk Insulation Samples

September 30, 2001

Effective through

For the National Institute of Standards and Technology

United States Department of Commerce
National Institute of Standards and Technology



ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

NVL LABORATORIES, INC.
SEATTLE, WA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

BULK ASBESTOS FIBER ANALYSIS

September 30, 2001
Effective through

David E. Alderman
For the National Institute of Standards and Technology

NVLAP Lab Code: 102063-0

The American Industrial Hygiene Association

is proud to acknowledge that

NVL Laboratories, Inc.
Seattle, WA

has fulfilled the requirements for and has been formally recognized by AIHA and is technically competent to perform the analyses listed in the following

SCOPE OF ACCREDITATION

INDUSTRIAL HYGIENE

Originally Accredited: 04/01/97

- Metals
- Asbestos PCM
- Organic Solvents
- Silica
- Asbestos PLM
- Diffusive Samples

ENVIRONMENTAL LEAD

Originally Accredited: 02/01/97

- Paint Chips
- Dust Wipes
- Air
- Soil

ENVIRONMENTAL MICROBIOLOGY

- Bacteria
- Fungi

The above named laboratory agrees to perform all analyses listed above in the scope of accreditation according to applicable policy requirements and acknowledges that continued accreditation is dependent on successful participation in the appropriate proficiency testing programs. This laboratory may be contacted to verify the current scope of accreditation, proficiency testing performance and accreditation status. Accreditation by AIHA is not a guarantee of the validity of the data generated by the laboratory.

Laboratory # 101861

Certificate # 563

Colleen Becker
Colleen Becker

Chair, Analytical Accreditation Board



James R. Thornton
James R. Thornton, CIH, CSP
President, AIHA

Accreditation Expires: 02/01/03

BENJAMIN J. CAVETANO
GOVERNOR OF HAWAII



BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to
file

May 9, 2001

NVL Laboratories, Inc.
4708 Aurora Avenue N
Seattle, Washington 98103

Dear Sir or Madam:

Your Laboratory Registration packet has been received and processed. The registration number is L-01-006 and your registration is valid until March 27, 2002.

Enclosed is your Receipt #2001-316, for Check #10489 in the amount of \$100.00 - Registration fee.

Thank you for your cooperation. Should you have any questions or require additional information, please contact Mr. Shawn Haruno at (808) 586-5800.

Sincerely,

James E. Jones
for Russell S. Takata
Program Manager
Noise, Radiation & Indoor Air Quality Branch

Enc: As stated

sh

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-- End of Section Table of Contents --

SECTION 13281A

LEAD HAZARD CONTROL ACTIVITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM E 1553 (1993) Practice for Collection of Airborne Particulate Lead During Abatement and Construction Activities
- ASTM E 1613 (1999) Standard Test Method for Determination of Lead by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), Flame Atomic Absorption Spectrometry (FAAS), or Graphite Furnace Atomic Absorption (GFAAS) Techniques
- ASTM E 1726 (1995) Sample Digestion of Soils for the Determination of Lead by Atomic Spectrometry
- ASTM E 1727 (1999) Field Collection of Soil Samples for Lead Determination by Atomic Spectrometry Techniques
- ASTM E 1741 (2000) Preparation of Airborne Particulate Lead Samples Collected During Abatement and Construction Activities for Subsequent Analysis by Atomic Spectrometry

HAWAII STATE OCCUPATIONAL SAFETY AND HEALTH (HIOSH)

- HIOSH 12-148 Asbestos

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

- NIOSH Pub No. 84-100 (1984; Supple 1985, 1987, 1988 & 1990)
NIOSH Manual of Analytical Methods

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

24 CFR 35	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures

1.2 DEFINITIONS

- a. Lead Hazard Control Activity - Any construction work where a worker may be occupationally exposed to lead and procedures have to be followed to assure that: 1). Lead inside the lead hazard control area is cleaned up to appropriate levels and 2). Lead dust does not disperse outside the lead hazard control area at unacceptable levels.
- b. Public/Commercial Building - Buildings on real property, including residential real property, generally accessible to the public except target housing, child occupied facilities and industrial buildings. Examples include offices, stores/shopping centers, churches, schools, barracks, hospitals, museums, airports, hotels, convention centers.

1.3 DESCRIPTION OF WORK

The Whole Barracks Renewal (WBR) Phase 2C2/2D at Schofield Barracks will require the Contractor to demolish buildings 845, 846, 847, T-876 and T-876A. Due to the age of the buildings, a lead paint survey was not completed. The paint is assumed to contain lead on the interior and exterior of the buildings.

During the demolition, personal protective equipment and air monitoring (personal and environmental) shall be taken. The Contractor should establish an exposure assessment by taking personal samples to document workers (demolition crew, back hoe drivers, etc.) exposure to lead for at least 5 days. Environmental area monitoring shall be conducted until demolition is completed.

Composite soil samples shall be taken for each individual building before (baseline) and after demolition is completed. Toxicity Characteristic Leaching Procedure (TCLP) tests have been completed for Building 846 and 847 (see attached report). TCLP samples shall be taken for the remaining buildings. Since these buildings are used as barracks, it will be exempt from hazardous waste disposal regulations. The waste generated is

considered residential waste. The landfill will require the TCLP results.

1.3.1 Coordination with Other Work

The contractor shall coordinate lead hazard control activities with work being performed in adjacent areas. Coordination procedures shall be explained in the Contractor's Accident Prevention Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead hazard control activities.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials and Equipment; G
Expendable Supplies; G

A description of the materials, equipment and expendable supplies required; including Material Safety Data Sheets (MSDSs) for material brought onsite to perform the work.

Qualifications; G

A report providing evidence of qualifications and designating responsibilities for personnel and laboratories.

SD-06 Test Reports

Licences, Permits, and Notifications; G
Accident Prevention Plan (APP); G

A report describing how the Contractor will protect workers, while performing lead hazard control activities; and how project clearance will be performed.

Sampling and Analysis; G

A log of the analytical results required for the sampling. The log shall be kept current.

Report prepared by the QSHP.

1.5 QUALIFICATIONS

1.5.1 Qualifications and Organization Report

The Contractor shall furnish a qualification and organization report. The

report shall describe the qualifications of the qualified safety and health professional (QSHP), onsite safety and health supervisor (OSHS), labor staff and the independent risk assessor. The report shall include an organization chart showing the Contractor's personnel by name and title and project specific responsibilities and authorities. The report shall describe the qualifications of the laboratories selected for this project. The report shall be signed by the Contractor and the qualified safety and health professional to indicate that all personnel and laboratories comply with certification and experience requirements of this section and that project personnel have been given the authority to complete the tasks assigned to them.

1.5.2 Personnel and Subcontractor Responsibilities and Qualifications

1.5.2.1 Qualified Safety and Health Professional (QSHP)

The QSHP shall be responsible for development of project specific requirements in the Accident Prevention Plan (APP); supervise implementation of the APP requirements; visit the site as needed to verify effectiveness of the APP and to coordinate resolution of unknown situations that may develop as the work progresses; be available to provide consultation to the Onsite Safety and Health Supervisor (OSHS); review sampling and analytical results to evaluate occupational exposure levels, verify effectiveness of controls. The QSHP shall have demonstrable experience with the implementation of occupational safety and health regulations.

1.5.2.2 Lead Hazard Control Workers

Lead Hazard Control workers shall be responsible for performing the labor necessary to complete the lead hazard control activities required in this contract.

1.5.2.3 Independent Certified Risk Assessor

The independent Certified Risk Assessor shall be a subcontractor to the prime Contractor on the project. The risk assessor shall be responsible to perform the sampling and evaluating the analytical data.

1.5.2.4 Testing Laboratories

The laboratory selected to perform analysis on paint chip, soil or dust wipe samples shall be accredited by EPA's National Lead Laboratory Accreditation Program (NLLAP). The laboratory selected perform analysis on worker exposure (industrial hygiene) samples shall be in the American Industrial Hygiene Association's Industrial Hygiene Laboratory Accreditation Program (IHLAP) and shall be successfully participating in the Proficiency Analytical Testing (PAT) program for lead.

1.5.2.5 Blood Lead Testing

The laboratory selected to perform analysis on worker blood samples shall be approved by OSHA and meet the requirements contained in http://www.osha-slc.gov/OCIS/toc_bloodlead.html.

1.5.2.6 Disposal Facility and Transporter

The Contractor shall furnish written evidence that the landfill to be used is approved for lead disposal by USEPA and state and local requirements. Copies of any required signed agreements between the Contractor (including subcontractors and transporters) and the lead disposal facility shall be provided.

1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements of this specification, work shall be performed in accordance with requirements of EM 385-1-1 and applicable regulations including, but not limited to 29 CFR 1910, 29 CFR 1926, especially Section .62, and the accepted Accident Prevention Plan with Appendices. Matters of interpretation of the standards shall be resolved to the satisfaction of and with the concurrence of, the Contracting Officer before starting work. Where these requirements vary, the most stringent shall apply. The following State and local statutes, regulations and requirements apply to lead hazard control activities to be performed: State, HIOSH 12-148.

1.7 ACCIDENT PREVENTION PLAN (APP)

1.7.1 APP Content and Organization

The Contractor's Accident Prevention Plan shall be organized into 5 parts, consisting of the overall plan and 4 appendices. The overall plan shall address each element in Appendix A of EM 385-1-1 in project specific detail. The elements are: a. Signature Sheet, b. Background Information, c. Statement of Safety and Health Policy, d. Responsibilities and Lines of Authorities, e. Subcontractors and Suppliers, f. Training, g. Safety and Health Inspections, h. Safety and Health Expectations, Incentive Programs and Compliance, i. Accident Reporting, j. Medical Support, k. Corporate Plans and Programs required by this contract, (HAZCOM, Respiratory Protection).

1.7.1.1 Lead Hazard Control Plan Appendix

The Lead Hazard Control Appendix shall address occupational exposure issues and shall describe the procedures to be followed to protect employees from lead hazards while performing lead hazard control activities. Each of the following elements shall be addressed in the lead hazard control appendix:

- a. The location and a brief description of each work activity that will emit lead into the workplace atmosphere. A description of any components containing lead shall be included and keyed to the project drawings.
- b. Description of equipment and materials, controls, crew size, worker responsibilities, and operating and maintenance procedures.
- c. Description and sketch of the Lead Hazard Control Areas, including decontamination areas.

- d. Description of the specific lead control methods and procedures to protect workers and other onsite contractors from lead exposure.
- e. Technologic equipment used to keep occupational exposure below the Permissible Exposure Limit and minimize worker exposure to lead (i.e., HEPA-filtered vacuum equipment/cleaners, special negative air enclosure equipment and supplies, etc.).
- f. Worker Exposure Assessment including methods and procedures to monitor and document worker exposure to lead. Worker exposure monitoring shall be broken into two parts in the plan. Part A: Initial Determination. The Contractor shall describe worker monitoring (if performed for the "initial determination" described in 29 CFR 1926 (.62) (d). Monitoring for the initial determination may be omitted from the plan if the Contractor has sufficient proof from previous operations as specified in 29 CFR 1926 (.62) (d)(3)(iii) and (iv) that workers will not be exposed over the action level. The Contractor shall substitute objective proof of action level compliance in Part A if "initial determination" monitoring is omitted. Part B: Continued Exposure Monitoring. Worker exposure monitoring after the initial lead exposure determination has been made.
- g. Work Practices Program describing the protective clothing to be used to protect workers from lead exposure, house keeping procedures employed to minimize spread on lead contamination in the lead hazard control area, hygiene facilities and practices used to prevent workers from inadvertent ingestion of lead.
- h. Administrative Control Procedures, to be used as a last resort, to limit worker exposure to lead. The worker rotation schedule to be employed, should engineering or personal protective equipment precautions fail to be effective, shall be described. This element of the plan shall be omitted if administrative controls will not be used.
- i. Medical Surveillance practices and procedures used to monitor worker exposure to lead and to assure fitness for wearing respiratory protection devices.
- j. Worker training meeting the requirements of 29 CFR 1926 Sections (.62) and (.59) to assure workers understand hazard associated with working with lead and how to protect themselves.
- k. Security: Fenced and locked security area for each lead hazard control area. A log book shall be kept documenting entry into and out of the lead hazard control area. Entry into lead hazard control areas shall only be by personnel authorized by the Contractor and the Contracting Officer. Persons entering control areas shall be trained, medically evaluated, and equipped with personal protective equipment required for the specific control area to be entered.

1.7.1.2 Activity Hazard Analyses Appendix

An Activity Hazard Analysis (AHA) shall be prepared for each work task data element specified on the individual work task data element sheets at the end of this section. The AHA shall be submitted to the Contracting Officer prior to beginning specified work. Format shall be in accordance with EM 385-1-1, figure 1-1. The AHA shall be continuously reviewed and modified, when appropriate, to address changing conditions or operations. Each accepted AHA shall be appended to and become part of the APP.

1.8 PRE-CONSTRUCTION SAFETY CONFERENCE

1.8.1 Conference General Requirements

The Contractor and the QSHP shall attend a pre-construction safety conference prior to starting work. Items required to be submitted shall be reviewed for completeness, and where specified, for acceptance. Details of the APP shall be revised to correct any deficiencies, and resubmitted for acceptance. Onsite work shall not begin until the APP has been accepted, unless otherwise authorized by the Contracting Officer. One copy of the APP shall be maintained in the Contractor's jobsite file, and a second copy shall be posted where it will be accessible to personnel on the site. As work proceeds, the APP shall be adapted to new situations and conditions. Changes to the APP shall be made by the QSHP with acceptance by the Contracting Officer. Should an unforeseen hazard become evident during performance of the work, the QSHP shall inform the Contracting Officer, both verbally and in writing, for immediate resolution. In the interim, the QSHP shall take necessary action to re-establish and maintain safe working conditions; and to safeguard onsite personnel, visitors, the public, and the environment. Disregard for provisions of this specification, or the accepted APP, shall be cause for stopping of work until the matter is rectified.

1.8.2 Preparatory Inspection Meeting

The Contractor shall arrange and hold a preparatory inspection meeting to review completeness and adequacy of the APP immediately prior to beginning each phase of work.

1.9 MEDICAL SURVEILLANCE REQUIREMENTS

The Contractor shall comply with the following medical surveillance requirements:

- a. The Contractor shall make every attempt to keep occupational exposure to lead on this project below the action level of 30 micrograms/cubic meter defined in 29 CFR 1926 (.62). If it is not possible, and if occupational exposures could possibly exceed the action level for 30 or more days per year, the Contractor shall institute a medical surveillance program. The program shall meet the examination frequency and content requirements specified in paragraph (j)(1), (j)(2) and (j)(3) of 29 CFR 1926 (.62). Medical removal as specified in paragraph (k) of 29 CFR 1926 (.62), if necessary, shall be at the Contractor's expense.

- b. Medical surveillance and biological monitoring shall be in compliance with 29 CFR 1926 (.62) (g) and (j). Initial biological monitoring shall be performed on lead hazard control workers prior to assignment to the project. Workers shall not be assigned to the project if results indicate a need for restricted activities.
- c. All lead hazard control workers shall pass the medical examinations necessary to be approved by the occupational physician to wear respiratory protection on this project. Occupational physician's approval shall be given prior to assignment to the project.

1.10 RESPIRATORY PROTECTION PROGRAM

The Contractor shall have a written respiratory protection program and shall be fully capable of implementing the requirement of the respiratory protection program on this project. The respiratory protection program shall meet the requirements of 29 CFR 1926 (.62) and 29 CFR 1910 (.134). Project specific respiratory protection requirements shall be included in the lead hazard control plan appendix of the Contractor's accident prevention plan.

1.11 LICENCES, PERMITS AND NOTIFICATIONS

The Contractor shall certify in writing to the Regional Office of the EPA state's environmental protection agency responsible for lead hazard activities and the Contracting Officer at least 10 days prior to the commencement of work that licenses, permits and notifications have been obtained. The Contractor is responsible for all associated fees or costs incurred in obtaining the licenses, permits and notifications.

1.12 TRAINING

1.12.1 OSHA Training Requirements

All Contractor personnel and/or subcontractors performing or responsible for onsite oversight of lead hazard control activities shall meet the following training requirements.

- a. Content of 29 CFR 1926 (.62) and its appendices.
- b. How operations could result in exposure over the action level.
- c. Purpose, selection, fitting, use and limitations of respirators.
- d. Purpose and description of the medical surveillance program.
- e. Use of engineering controls and good work practices to limit occupational exposure to lead.
- f. Implementation of the lead hazard control plan appendix of the accident prevention plan.

- g. Medical supervision for the use of chelating agents.
- h. Employee right of access to medical surveillance records as specified in 29 CFR 1910 (.20).

1.12.2 Qualified Safety and Health Professional

The qualified safety and health professional shall meet the training requirements in paragraph 1.12.1 and shall meet the training, experience and authority requirements in 29 CFR 1926 (.62) to be a competent person and be trained and have the experience and education to meet 40 CFR 745 Subpart L requirements to carry the following certifications:

- a. Certified Risk Assessor
- b. Certified Supervisor

1.12.3 Independent Risk Assessor

The independent risk assessor shall meet the training requirements in paragraph OSHA Training Requirements, above, and shall meet the training and experience requirements in 40 CFR 745 to carry certification as a certified risk assessor.

1.12.4 Abatement Worker

Workers shall meet the OSHA Training Requirements specified above and the training requirements in 40 CFR 745 Subpart L to carry certification as a Certified Worker, if required.

1.12.5 Training Program Certification

Training to meet 40 CFR 745 Subpart L requirements shall be provided by an EPA accredited training provider and the Contractor shall provide proof in the Qualifications and Organization Report showing that personnel have passed certification examinations for their respective disciplines, that fees for certification have been paid to the EPA (or to the state for state-run programs) and that EPA has certified the QSHP, independent risk assessor, certified workers to perform their duties.

1.13 SAMPLING AND ANALYSIS

1.13.1 Sampling and Analytical Procedures

1.13.1.1 Sampling and Analysis Methods

Analysis shall conform to NIOSH Pub No. 84-100 Method 7082, Lead, for personal sampling required by 29 CFR 1926 (.62), ASTM E 1613. Sampling shall conform to ASTM E 1553, ASTM E 1741.

1.13.1.2 Soil Sampling and Analysis

Sampling shall conform to ASTM E 1727, ASTM E 1726. Analysis shall conform to ASTM E 1613.

1.13.2 Occupational Exposure Assessment

Sampling and analytical procedures to determine compliance with the occupational exposure monitoring requirement of this section shall be described in the lead hazard control plan appendix of the Contractor's accident prevention plan. Monitoring for the initial determination may be omitted if the Contractor has sufficient proof from previous operations as specified in 29 CFR 1926 (.62) (d)(3)(iii) and (iv) that workers will not be exposed over the action level. The following occupational exposure monitoring requirements apply and shall be implemented if the requirements of 29 CFR 1926 (.62)(d)(3) (iii) and (iv) cannot be demonstrated.

- a. During Initial Monitoring the Contractor shall representatively sample employees with the greatest potential for exposure to aerosolized lead.
- b. Continued/Additional Monitoring shall meet applicable paragraphs in 29 CFR 1926 (.62)(d)(6), Frequency, after the initial determination has been made.

1.13.3 Lead Hazard Control Area/Containment Monitoring

The Contractor shall perform a visual inspection once per day outside the lead hazard control area to assure visual clearance criteria are maintained while lead hazard control activities are performed. The Contractor shall clean at its own expense, and to the Contracting Officer's satisfaction, all contaminated surfaces outside the lead hazard control area.

1.13.4 Waste Disposal Sampling

The Contractor shall sample the following waste streams for TCLP analysis to determine waste disposal requirements.

- a. The Contractor shall take composite/Bldg that has not been tested: See section 1.3 Description of work samples of building demolition debris.
- b. The Contractor shall take 1 per composite Bldg. soil sample for baseline and 1/bldg after demolition has been completed.

1.13.5 Analytical Results

The Contractor shall develop and maintain during the course of the project a log of analytical results generated by the above sampling requirements. The log shall clearly describe the reason for which the sample was taken (worker exposure, migration control, clearance) the analytical result for each sample and evaluate if the analytical result passed or failed the action levels. At a minimum, the Contractor shall include analytical results for samples required to be taken in paragraphs Occupational Exposure Assessment, Lead Hazard Control Area/Containment Monitoring, Occupancy During Work, and Clearance Monitoring specified above.

1.14 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor shall describe the PPE to be used to protect workers from lead hazards in the Lead Hazard Control Plan Appendix of the Accident Prevention Plan. The Contractor shall furnish, at no cost to the workers, clothing for protection from lead-contaminated dust and debris. An adequate supply of these items shall be available for worker and Government personnel use. Protective clothing shall include:

- a. Coveralls : Full-body moisture permeable (breathable) disposable coveralls shall be provided to lead hazard control workers.
- b. Boots: Boots and shoes shall be provided as required by EM 385-1-1 Section 05.A.08 for workers. Boot/shoe covers shall be provided to prevent contamination of boots and shoes.
- c. Hand Protection: Gloves, etc., shall be provided as required by EM 385-1-1 Section 05.A.10 for workers.
- d. Head Protection: Hard hats shall be provided as required by 29 CFR 1910 (.135) and EM 385-1-1 Section 05.D for workers and authorized visitors.
- e. Eye and Face Protection: Eye and face protection shall be provided as required by 29 CFR 1910 (.133) and EM 385-1-1 Section 05.B for workers and authorized visitors.
- f. Respirators: NIOSH certified air-purifying respirators or filtering face pieces shall be provided for use as respiratory protection for airborne lead and for other hazardous airborne contaminants that may be encountered; as determine by the on-site safety and health supervisor. At a minimum, respirators shall be furnished to each employee required to enter a lead hazard control area where an employee exposure assessment has not yet been performed, or where monitoring data establishes the need for respiratory protection, or if requested by the employee.
- g. Respirator Cartridges/Filtering Face Pieces: Respirator cartridges shall be changed out/filtering face pieces properly disposed of when the they become sufficiently loaded with particulate matter that workers experience breathing resistance. Cartridges and filtering face pieces shall be N, R or P 100 rated to assure sufficient protection from lead exposure.

1.15 HYGIENE FACILITIES

The Contractor shall describe the personal hygiene facilities to be used by the workers in the Lead Hazard Control Plan Appendix of the Accident Prevention Plan. The Contractor shall provide hygiene facilities for lead hazard control workers. Hygiene facilities shall consist of the following:

1.15.1 Hand Wash Stations

The Contractor shall provide hand washing facilities for use by lead hazard control workers. Hand washing facilities shall comply with the requirements in 29 CFR 1926 (.51) (f). Faces and hands shall be washed

when leaving the lead hazard control area and after each work-shift if showers are not provided.

1.15.2 Change Area

The Contractor shall provide a change area to workers. The change area shall be equipped so that contaminated work clothing and street clothes shall be stored separately to prevent cross contamination.

1.15.3 Eating Area

The Contractor shall set aside an area or provide a room for taking breaks and eating lunch. This area shall be kept as free as practicable from lead contamination. Workers shall be required to follow the procedures in 29 CFR 1926 (.62) (i)(4) when using the room.

1.16 POSTED WARNINGS AND NOTICES

The following regulations, warnings, and notices shall be posted at the worksite in accordance with 29 CFR 1926 (.62).

1.16.1 Regulations

At least two copies of 29 CFR 1926 (.62) shall be made available for use by either the Contracting Officer or affected workers; and for the purpose of providing required information and training to the workers involved in the project. One copy shall be maintained in the Contractor's jobsite file, and a second copy shall be posted where it will be accessible to workers on the site.

1.16.2 Warning Signs and Labels

Warning signs shall be posted in each lead hazard control area where worker exposure to lead is undetermined or where the exposures are above the permissible exposure limit as defined in 29 CFR 1926 (.62). Signs shall be located to allow personnel to read the signs and take necessary precautions before entering the lead hazard control area.

1.16.2.1 Warning Signs

Warning signs shall be in English, be of sufficient size to be clearly legible, and display the following:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

1.16.2.2 Warning Labels

Warning labels shall be affixed to all lead waste disposal containers used to hold materials, debris and other products contaminated with lead hazards; warning labels shall be in English, and be of sufficient size to be clearly legible, and display the following:

CAUTION: CLOTHING CONTAMINATED WITH LEAD. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE OR LOCAL REGULATIONS.

1.16.3 Worker Information

Right-to-know notices shall be placed in clearly visible areas accessible to personnel on the site, to comply with Federal, state, and local regulations.

1.16.4 Air Monitoring Results

Air monitoring results shall be prepared so as to be easily understood by the workers. One copy shall be maintained in the Contractor's jobsite file, and a second copy shall be posted where it will be accessible to the workers as specified in 29 CFR 1926 (.62).

1.16.5 Emergency Telephone Numbers

A list of emergency telephone numbers shall be posted at the site. The list shall include numbers of the local hospital, emergency squad, police and fire departments, Government and Contractor representatives who can be reached 24 hours per day, and professional consultants directly involved in the project.

1.17 MATERIALS AND EQUIPMENT

Sufficient quantities of health and safety materials required by 29 CFR 1926 (.62), and other materials and equipment needed to complete the project, shall be available and kept on the site.

1.18 STORAGE OF MATERIALS

Materials shall be stored protected from damage and contamination. Flammable or hazardous materials shall not be stored inside a building. Materials shall be regularly inspected to identify damaged or deteriorating items. Damaged or deteriorated items shall not be used and shall be removed from the site as soon as they are discovered. Stored materials shall not present a hazard or an inconvenience to workers, visitors, and/or other occupants and employees of the facility in which they are located.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 WORK PROCEDURES

The Contractor shall perform work following practices and procedures described accident prevention plan.

3.1.1 Lead Hazard Control Areas, Equipment and Procedures

The Contractor shall set up lead hazard control areas and operate equipment within the lead hazard control area in a manner that will minimize migration of lead dust beyond the lead hazard control area boundaries and minimize exposure to workers.

3.1.2 Lead Hazard Control Areas

Access into lead hazard control areas by the general public shall be prohibited. Workers entering the lead hazard control area shall meet medical surveillance requirements of this contract and shall be required to understand and follow procedures described in the Contractor's accident prevention plan for reducing lead exposure. Lead hazard control area preparation and restriction requirements follow:

- a. Containment features for exterior lead hazard control projects:
Colored caution tape. A roped-off boundary perimeter, using caution tape or a barrier installed at 25A distance from where the lead control work is performed.

3.2 USE OF HYGIENE FACILITIES

- a. Personnel and equipment shall be decontaminated when exiting the lead hazard control area. The Contractor shall comply with the following personnel and equipment decontamination procedures:
 - (1) HEPA vacuum outer garments and equipment.
 - (2) Wet Wipe Equipment.
 - (3) Remove outer layer of garments.
 - (4) Thoroughly wash face and hands, if showering not required.
 - (5) Shower (if applicable).
 - (6) Remove Respirator (if applicable).
 - (7) Exit lead hazard control area.
- b. The Contractor shall provide, and workers shall use, a change room to change into work clothing at the beginning of a work shift. At the end of the work shift workers shall change back into street clothing and leave contaminated work clothing at the site for disposal or laundering.
- c. The Contractor shall provide an eating facility as free as practical from lead contamination. Workers shall be allowed usage of the eating facility for rest/lunch breaks.

3.3 WASTE DISPOSAL PROCEDURES

3.3.1 Construction Debris and/or Sanitary Landfill Waste

The Contractor shall dispose of the following waste streams in a construction debris landfill: Building Demolition Debris, Used Personal Protective Equipment, Disposable material from containment structures. The Bldgs used as barracks (845, 846 and 847) is exempt from hazardous waste disposal rules and may be disposed of a regular construction debris.

3.3.2 Waste Stream Classification

The Contractor shall determine the RCRA waste classification for all waste streams generated by the lead hazard control project. The Contractor shall perform the sampling and analysis specified in paragraph WASTE DISPOSAL, evaluate analytical results and propose waste stream treatment and disposal requirements for the contract. The Contracting Officer will approve waste stream treatment and disposal requirements proposed by the Contractor.

3.3.3 RCRA Subtitle C Hazardous Waste

The Contractor shall dispose of the following waste streams at the RCRA subtitle C Treatment Storage and Disposal Facility or at the RCRA subtitle C hazardous wastes landfill: Building demolition debris if TCLP is greater than 5 ppm for lead. Dust and paint chips from HEPA vacuuming operations.

3.3.4 Hazardous Waste Transportation and Disposal

The Contractor shall transport, treat and dispose of hazardous waste in accordance with the requirements of Section 01430 ENVIRONMENTAL PROTECTION.

3.4 CLEARANCE PROCEDURES

3.4.1 Visual Inspection

QSHP shall perform a visual inspection, using the form at the end of this section, for each lead hazard control area to assure that lead hazard control activities, identified in the individual work task data elements, have been properly completed. The QSHP shall visually verify that lead hazards have been removed, control technology has been appropriately applied/installed and that the lead hazard control area is free of dust and paint chips generated by lead hazard control activities.

3.5 EVALUATION OF SAMPLING AND MONITORING RESULTS

Analytical results from samples taken during lead hazard control activities shall be evaluated to determine compliance with occupational safety and health standards and project specific control efficiency and clearance/clean up levels.

3.5.1 Occupational Safety and Health

The QSHP shall review the analytical results from samples taken for the initial exposure assessment and continued occupational safety and health monitoring if required. Effectiveness and adequacy of personal protective equipment, respirators, work practices, hygiene facilities and personal decontamination procedures shall be evaluated and upgrades/downgrades in equipment and procedures made. After notifying the Contracting Officer the following shall be applied:

a. Exposures over the PEL (0.05 mg/cubic meter):

- (1) Improve work practices to reduce exposures.

- (2) Don respirators.
 - (3) Assure eating facilities and change rooms are clean and are free from settled dust.
 - (4) Shower as part of personal decontamination.
- b. Exposures over the Action Level (0.03 mg/cubic meter):
- (1) Assure exposed individuals enrolled in the medical surveillance program.
 - (2) Assure exposed individuals enrolled in and up to date with lead exposure training requirements.

3.5.2 Control Efficiency of Containment Features

The QSHP shall review and document results of the visual inspection determining visual clearance criteria are being met while lead hazard control activities are being performed. The QSHP shall review analytical results from samples taken to determine if lead is migrating outside lead hazard control areas at levels in excess of clearance criteria. The QSHP shall notify the Contracting Officer and apply the following actions if results exceed project specific clearance levels outside the lead hazard control area:

- a. Require/improve containment.
- b. Improve work practices to reduce lead aerosol generation.

3.5.3 Removal of Lead Hazard Control Area

Upon acceptance of the final clearance certification by the Contracting Officer, and when authorized, cleared Lead Hazard Control Area boundary controls and warning signs shall be removed.

3.6 CLEARANCE REPORT

The QSHP shall prepare a clearance report including the following information:

- a. Start and completion dates of lead hazard control activities.
- b. Type of lead hazard control activity performed (i.e., abatement, interim control, renovation, remodeling), locations and lead hazards controlled or abated.
- c. The name and address of each firm conducting lead hazard control activities and the name of each supervisor assigned to the project.
- d. The name, address and signature of the QSHP or independent risk assessor to indicate clearance requirements have been met.
- e. Certification of each Final Cleaning and Visual Inspection

performed by the QSHP.

- f. Analytical results from clearance sampling performed by the QSHP or independent risk assessor, the name of the laboratory that conducted the analysis. Results shall be provided in both the laboratory report and on the appropriate example forms provided at the end of this section.
- g. A detailed written description of the lead hazard control activities performed, including hazard control methods used, locations of rooms and/or components where lead hazard control activities occurred, reason for selecting particular hazard control methods for each component, and any suggested monitoring of encapsulants or enclosures.
- h. Hazardous waste disposal documentation.
- i. Contractor provided installation/maintenance manuals.

3.7 TITLE TO MATERIALS

Materials resulting from demolition work, except as specified otherwise, shall be come the property of the Contractor, and shall be disposed of in accordance with Section 02220 DEMOLITION, except as specified.

3.8 CERTIFICATION OF VISUAL INSPECTION

Certify that the lead hazard control ares(s) for each individual work task data elements have passed visual clearance criteria and are ready for clearance sampling. To pass visual clearance, lead hazards have to be removed; control technology appropriately applied/installed; the lead hazard control area must be free from visible dust debris, paint chips or any other residue that may have been generated by the lead hazard control activities.

Date of sample collection _____ Date Shipped to lab _____

Shipped by _____

Signature

I certify that the clearance samples taken meet the clearance sampling requirements of this contract.

By: _____ Date: _____

QSHP or independent risk assessor

Print name and Title: _____

CONTRACTING OFFICER ACCEPTANCE OR REJECTION

I have inspected sampling locations and procedures and have found them to be _____ Acceptable, meet contract requirements.

_____ Unacceptable, do not meet contract requirements, Contractor is directed to resample.

By: Contracting Officer's Representative

Signature

Date

Print Name and Title _____

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet _____ of _____

There is a separate data sheet for each individual work task.

WORK TASK DESIGNATION NUMBER: _____

- 2. LOCATION OF WORK TASK:
- 3. BRIEF DESCRIPTION OF THE LEAD HAZARD CONTROL ACTIVITY:
- 4. POST LEAD HAZARD CONTROL BUILDING/FACILITY USE: TARGET HOUSING/CHILD OCCUPIED FACILITY OFFERED FOR SALE TARGET HOUSING/CHILD OCCUPIED ACTIVE FACILITY COMMERCIAL/PUBLIC INDUSTRIAL
- 5. LEAD CONTAMINATED DEBRIS DISPOSAL DESTINATION: Construction Debris/Sanitary RCRA subtitle C Treatments Storage and Disposal Landfill RCRA subtitle C Landfill
- 6. CLEARANCE REQUIREMENTS: 40 CFR 745, 24 CFR 35, VISUAL

-- End of Section --

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13286N

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SECTION 13286N

HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal FacilitiesRef Title
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Program
40 CFR 273	Standards For Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use ProhibitionsRef Title
49 CFR 178	Shipping Container Specification

1.2 REQUIREMENTS

Removal and disposal of PCB containing lighting ballasts and associated mercury-containing lamps. Contractor may encounter leaking PCB ballasts.

1.3 DEFINITIONS

1.3.1 Certified Industrial Hygienist (CIH)

A industrial hygienist hired by the contractor shall be certified by the American Board of Industrial Hygiene.

1.3.2 Leak

Leak or leaking means any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

1.3.3 Lamps

Lamp, also referred to as "universal waste lamp", is defined as the bulb or tube portion of an electric lighting device. A lamp is specifically designed to produce radiant energy, most often in the ultraviolet, visible, and infra-red regions of the electromagnetic spectrum. Examples of common universal waste electric lamps include, but are not limited to, fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide lamps.

1.3.4 Polychlorinated Biphenyls (PCBs)

PCBs as used in this specification shall mean the same as PCBs, PCB containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3, Definitions.

1.3.5 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

1.3.6 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

- (1) Batteries as described in Sec. 273.2 of this chapter;
- (2) Pesticides as described in Sec. 273.3 of this chapter;
- (3) Thermostats as described in Sec. 273.4 of this chapter; and
- (4) Lamps as described in Sec. 273.5 of this chapter.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

Perform PCB related work in accordance with 40 CFR 761. Perform mercury-containing lamps storage and transport in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273.

1.4.2 Training

Certified industrial hygienist (CIH) shall instruct and certify the training of all persons involved in the removal of PCB containing lighting ballasts and mercury-containing lamps. The instruction shall include: The dangers of PCB and mercury exposure, decontamination, safe work practices, and applicable OSHA and EPA regulations. The CIH shall review and approve the PCB and Mercury-Containing Lamp Removal Work Plans.

1.4.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site of 29 CFR 1910.1000, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 265, 40 CFR 268, 40 CFR 270, and 40 CFR 273 and of the Contractor removal work plan and disposal plan for PCB and for associated mercury-containing lamps.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-07 Certificates

- Qualifications of CIH; G
- Training Certification; G
- PCB and Lamp Removal Work Plan; G
- PCB and Lamp Disposal Plan; G

SD-11 Closeout Submittals

- Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers; G
- Certification of Decontamination
- Certificate of Disposal and/or recycling. Submit to the Government before application for payment within 30 days of the date that the disposal of the PCB and mercury-containing lamp waste identified on the manifest was completed.

DD Form 1348-1

Testing results

1.6 ENVIRONMENTAL REQUIREMENTS

Use special clothing:

- a. Disposable gloves (polyethylene)

- b. Eye protection
- c. PPE as required by CIH

1.7 SCHEDULING

Notify the Contracting Officer 20 days prior to the start of PCB and mercury-containing lamp removal work.

1.8 QUALITY ASSURANCE

1.8.1 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit training certification that the Industrial Hygienist is certified, including certification number and date of certification or re certification.

1.8.2 PCB and Lamp Removal Work Plan

Submit a job-specific plan within 20 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by the Certified Industrial Hygienist. Obtain approval of the plan by the Contracting Officer prior to the start of PCB and/or lamp removal work.

1.8.3 PCB and Lamp Disposal Plan

Submit a PCB and lamp Disposal Plan with 45 calendar days after award of contract. The PCB and Lamp Disposal Plan shall comply with applicable requirements of federal, state, and local PCB and Universal waste regulations and address:

- a. Estimated quantities of wastes to be generated, disposed of, and recycled.
- b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state PCB and mercury-containing lamp waste permit applications and EPA identification numbers, as required.
- c. Names and qualifications (experience and training) of personnel who will be working on-site with PCB and mercury-containing lamp wastes.
- d. Spill prevention, containment, and cleanup contingency measures to be implemented.
- e. Work plan and schedule for PCB and mercury-containing lamp waste

removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerize daily.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the removal of PCB containing lighting ballasts, associated mercury-containing fluorescent lamps, in accordance with local, state, or federal regulations.

Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced. Do not brake mercury containing fluorescent lamps or high intensity discharge lamps.

3.1.1 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761, 40 CFR 262 40 CFR 263, and the applicable requirements of this section, including but not limited to:

- a. Obtaining suitable PCB and mercury-containing lamp storage sites.
- b. Notifying Contracting Officer prior to commencing the operation.
- c. Reporting leaks and spills to the Contracting Officer.
- d. Cleaning up spills.
- e. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the Contracting Officer.
- f. Maintaining inspection, inventory and spill records.

3.2 PCB SPILL CLEANUP REQUIREMENTS

3.2.1 PCB Spills

Immediately report to the Contracting Officer any PCB spills.

3.2.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

3.2.3 PCB Spill Cleanup

40 CFR 761, subpart G. Initiate cleanup of spills as soon as possible, but

no later than 24 hours of its discovery. Mop up the liquid with rags or other conventional absorbent. The spent absorbent shall be properly contained and disposed of as solid PCB waste.

3.2.4 Records and Certification

Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide test results of cleanup and certification of decontamination.

3.3 REMOVAL

3.3.1 Ballasts

As ballast are removed from the lighting fixture, inspect label on ballast. Ballasts without a "No PCB" label shall be assumed to contain PCBs and containerized and disposed of as required under paragraphs STORAGE FOR DISPOSAL and DISPOSAL. If there are less than 1600 "No PCB" labeled lighting ballasts dispose of them as normal demolition debris. If there are more than 1600 "No PCB" labeled ballasts, establish whether the "No PCB" labeled ballasts contain diethylhexyl phthalate (DEHP) either by test or by checking with the ballast manufacturer indicated on the label. Submit testing results and/or written confirmation from the manufacturer to the Contracting Officer. If the ballasts do not contain DEHP, dispose of them as normal construction debris. If they do contain DEHP, dispose of them as hazardous material in accordance with Federal, State, and local regulations. As a basis of bid assume ballasts with "No PCB" labels do not contain DEHP and may disposed of as normal construction debris. If 1600 or more DEHP ballasts are disposed of in a 24 hour period, notify the National Response Team at 800-424-8802.

3.3.2 Lighting Lamps

Remove lighting tubes/lamps from the lighting fixture and carefully place (unbroken) into appropriate containers (original transport boxes or equivalent). In the event of a lighting tube/lamp breaking, sweep and place waste in double plastic taped bags and dispose of as universal waste as specified herein.

3.4 STORAGE FOR DISPOSAL

3.4.1 Storage Containers for PCBs

49 CFR 178. Store PCB in containers approved by DOT for PCB.

3.4.2 Storage Containers for lamps

Store mercury containing lamps in appropriate DOT containers. The boxes shall be stored and labeled for transport in accordance with 40 CFR 273.

3.4.3 Labeling of Waste Containers

Label with the following:

- a. Date the item was placed in storage and the name of the cognizant activity/building.
- b. "Caution Contains PCB," conforming to 40 CFR 761, CFR Subpart C. Affix labels to PCB waste containers.
- c. Label mercury-containing lamp waste in accordance with 40 CFR 273. Affix labels to all lighting waste containers.

3.5 DISPOSAL

Dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

3.5.1 Identification Number

Federal regulations 40 CFR 761, and 40 CFR 263 require that generators, transporters, commercial storers, and disposers of PCB waste possess U.S. EPA identification numbers. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work. For mercury containing lamp removal, Federal regulations 40 CFR 273 require that large quantity handlers of Universal waste (LQHUW) must provide notification of universal waste management to the appropriate EPA Region (or state director in authorized states), obtain an EPA identification number, and retain for three years records of off-site shipments of universal waste. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Universal Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work.

3.5.2 Transporter Certification

Comply with disposal and transportation requirements outlined in 40 CFR 761 and 40 CFR 263. Before transporting the PCB waste, sign and date the manifest acknowledging acceptance of the PCB waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities (EPA Form 7710-53).

3.5.2.1 Certificate of Disposal and/or Recycling

40 CFR 761. Certificate for the PCBs and PCB items disposed shall include:

- a. The identity of the disposal and or recycling facility, by name, address, and EPA identification number.
- b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

- c. A statement certifying the fact of disposal and or recycling of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.
- d. A certification as defined in 40 CFR 761.

-- End of Section --

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SECTION 13851A

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990; R 1996) Audible Emergency Evacuation Signal

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221 (1999) Installation, Maintenance and Use of Public Fire Service Communication Systems

NFPA 70 (1999) National Electrical Code

NFPA 72 (1999) National Fire Alarm Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1242 (1996; Rev Mar 1998) Intermediate Metal Conduit

UL 1971 (1995; Rev thru Apr 1999) Signaling Devices for the Hearing Impaired

UL 268 (1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems

UL 268A	(1998) Smoke Detectors for Duct Application
UL 38	(1999) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 464	(1996; Rev thru May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems
UL 6	(1997) Rigid Metal Conduit
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G, RE

Technical data which relates to computer software.

Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72

Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G, RE

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm Technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to

install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.
- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72.

A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC AND NAC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.

- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors
- c. Capability of each addressable device being individually disabled or enabled from the panel.

1.4.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of IDC and NAC. Smoke detectors shall not have combined alarm initiating and power circuits.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision

shall detect any open, short, or ground.

- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.
- i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.
- l. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.
- m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.
- n. Zones for IDC shall be arranged as indicated on the contract drawings.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of signals over the station radio fire reporting system.
- b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display.
- c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.
- d. Deactivation of the air handling units serving the alarmed area.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other devices. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.1.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 3.05 m and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible devices shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.1.5 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style D initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18

Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 1220 mm. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle or rate-compensating principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions as shown on drawings, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, mechanical

equipment rooms, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 57.2 degrees C. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 15 by 15 m.

2.5.1.2 Rate Compensating Detectors

Detectors shall be surface mounted horizontal type, with outlet box supported independently of wiring connections. Detectors shall be hermetically sealed and automatically resetting. Rate Compensated detectors shall be rated for 15 by 15 m.

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization or photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 1.5 meters per second in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.2.2 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.2.3 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry

shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 1.83 m and those mounted below 1.83 m that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.6.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box recessed vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 3.05 m.

Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be semi-flush mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for fire alarm dc circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.7.3 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is Monaco and the transceiver shall be fully compatible with this equipment. At the contractor's option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

- a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be

accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.8.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to the fire alarm system for the building. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.8.1.3 Antenna

The Contractor shall provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h.

Antennas shall not be mounted to any portion of the building roofing system.

2.8.2 Master Fire Alarm Boxes

Master fire alarm boxes shall be of the coded, positive noninterfering type with succession features having local energy type auxiliary tripping device, and of the prewound, open-door, pull-lever type. Mechanism shall be housed in a weatherproof cottage shell type of housing with metallic or rigid plastic code number plate mounted on the exterior face of the cottage shell. Operation of the actuating pull lever shall cause the box to transmit four complete rounds of code to gongs, recorders, and other devices on the same circuit. Driving springs shall have the capability to transmit not less than eight complete four-round groups of code before being rewound. Boxes shall be designed for operation of 100 milliamperes dc, but with capability of full operation of 70 milliamperes and up to 120 milliamperes. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Each box shall be equipped with manual signaling key, telephone jack, silent test device, and box shunt device. Box shall be wall-mounted with center of box 1525 mm above grade, and provided with lighting fixture. Mounting bolts, brackets, fastenings, and conduit shall be copper alloy, cadmium, or zinc-coated steel. Code wheel shall be metallic and box code shall be as directed. Electrically powered master fire alarm boxes shall have standby sealed, lead calcium battery capacity for a minimum of 72 hours and be capable of transmitting alarms during that period.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm nor more than 2000 mm above the finished floor. Manually operable controls shall be between 900 and 1100 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm from any part of any lighting fixture. Detectors shall be located at least 900 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, sway bracing shall be

provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.1.5 Notification Appliances

Notification appliances shall be mounted 2003 mm above the finished floor or 150 mm below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, NFPA 72, and as indicated on the drawings and as specified herein.

3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, and as indicated on the drawings and as specified herein.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff.

The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

FIRE ALARM SEQUENCE OF OPERATIONS MATRIX

System Input:	System output:
Sprinkler riser or floor water flow or pressure switch	Transmit alarm to Emergency Forces
Sprinkler valve tamper switch	Transmit Supervisory alarm to Emergency Forces
Elevator sprinkler flow switch (Elev riser in only, Wet pipe or preaction spike S/S)	Transmit Trouble Alarm to Emergency Forces
Loss of voltage to control circuit for the disconnecting elevator power	Activate visible and audible alarm annunciator
Elevator Machine Rm Smoke Detector	Activate visible and audible supervisory annunciator
Elevator lobby fire detection device, 1st floor	Activate visible and audible trouble annunciator
Elevator lobby fire detection device, alternate floor	Activate all occupant notification appliances
Elevator lobby fire detection device on other levels	Activate visible and audible elev machine room alarm annunciator
Manual call station	Release door to close
Stroke Detector for Release of Magnetic Door Holder rod on stair door	Activate sounder base alarms in all dwelling units in building
Dwelling unit Smoke Detector w/sounder base (multiple rooms in dwelling unit)	Activate all sounder base alarms in only dwelling unit
Single break or single ground fault in fire alarm circuit	Activate sounder base in dwelling unit room
Supply duct smoke detector (<2000 CFM)	Shut down air handling fan
Return duct smoke detector (<15000 CFM & vertical rafter thru floor)	Release all doors in stair to close if controlled by magnetic door holders
	Initiation devices and occupant notification appliances operation maintained
	Shutdown elevator power
	Initiate Special Elevator Recall (see elev spec)
	Initiate Elevator Emergency Recall Phase I, Cab to 1st floor
	Initiate Elevator Emergency Recall Phase I, Cab to alternate level
	Alarm annunciation in elevator cab
	Open preaction/deluge or dry pipe sprinkler valve
	Close all fire/smoke dampers in duct penetrating computer room well.
	Local sprinkler alarm gong activated upon sprinkler flow

- NOTES:
1. If sequence indicated here conflicts with specification, this control sequence supercedes specification sequence.
 2. The operation sequence indicated here is not complete. Provide other operations in accordance with NFPA 72 and Contract documents.
 3. This sequence of operations are considered to be minimum. Designer may add input/output with approved coordination with the Authority Having Jurisdiction.

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SECTION 13930A

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assembly
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AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
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AWWA B301 (1992; Addenda B301a - 1999) Liquid Chlorine

AWWA C104 (1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110 (1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA C111 (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C203 (1997; Addenda C203a - 1999) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C606 (1997) Grooved and Shouldered Joints

AWWA EWW (1999) Standard Methods for the Examination of Water and Wastewater

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.11 (1996) Forged Fittings, Socket-Welding and Threaded

ASME B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22 (1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.4 (1998) Gray Iron Threaded Fittings

ASME B16.9 (1993) Factory-Made Wrought Steel
Buttwelding Fittings

ASME B18.2.1 (1996) Square and Hex Bolts and Screws
(Inch Series)

ASME B18.2.2 (1987; R 1993) Square and Hex Nuts (Inch
Series)

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

FM P7825b (1998) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-71 (1997) Gray Iron Swing Check Valves,
Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1999) Installation of Sprinkler Systems

NFPA 14 (2003) Installation of Standpipe and Hose
Systems

NFPA 1963 (1998) Fire Hose Connections

NFPA 24 (1995) Installation of Private Fire
Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES
(NICET)

NICET 1014-7 (1995) Program Detail Manual for
Certification in the Field of Fire
Protection Engineering Technology (Field
Code 003) Subfield of Automatic Sprinkler
System Layout

UNDERWRITERS LABORATORIES (UL)

UL 668 (1995; Rev thru Dec 1998) Hose Valves for
Fire Protection Service

UL Bld Mat Dir (1999) Building Materials Directory

UL Fire Prot Dir (1999) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be contractor designed and installed in all areas of the building . The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. Reference to the authority having jurisdiction shall be interpreted to mean U.S. Army Engineer Division, Pacific Ocean Division Fire Protection Engineer.

1.2.1 Hydraulic Design

In general the system shall be hydraulically designed to discharge a minimum density as shown on the drawings over the hydraulically most demanding 280 square meters of floor area unless otherwise noted. The minimum pipe size for branch lines in gridded systems shall be 32 mm. Hydraulic calculations shall be in accordance with NFPA 13 and contract documents. Water velocity in the piping shall not exceed 6 m/s.

1.2.1.1 Hose Demand

An allowance for exterior hose streams of 1,893 L/min shall be added to the sprinkler system demand at the base of the sprinkler riser.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply conditions shown on the drawings. Water supply shall be presumed available at the base of the riser. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

For hydraulically designed systems the barracks building shall be designed using the residential sprinkler design method for dwelling units, corridor and lobby and room design method for central core area and mechanical rooms. The area density method shall be used for entire COFS, except the room design method shall use for the mechanical room. The designer shall design the sprinkler system based on grid or loop system for the COFS.

The manual wet standpipe shall be sized based on the pipe schedule method in accordance with NFPA 14.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13.

1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sprinkler System Shop Drawings; G.

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13.

Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Shop Drawings.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals; G.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Load Calculations for Sizing Sway Bracing; G.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Components and Equipment Data; G.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Preliminary Tests Procedures; G.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Final Acceptance Test Procedures; G.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

On-site Training Schedule; G.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Preliminary Tests; G.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Final Acceptance Test; G.

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Fire Protection Specialist Qualifications; G.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; G.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

SD-06 Test Reports

Preliminary Tests Report; G.

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping.

All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; G.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates

Fire Protection Specialist Inspection; G.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Wet Pipe Sprinkler System.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe

individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in the specification.

In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially

duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number on the plate permanently affixed to the item of equipment.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 150 mm above the floor to a point 1500 mm outside the building wall shall be ductile iron with a rated working pressure of 1034 kPa conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 1500 mm outside the building walls shall comply with Section 02510a WATER DISTRIBUTION SYSTEM.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or copper.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black schedule as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a

corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm thick, and full face or self-centering flat ring type.

2.5.1.5 Bolts, Nut, and Washers

Bolts shall be squarehead conforming to ASME B18.2.1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2. Washers shall meet the requirements of ASTM F 436M. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Copper Tube Components

2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B 88M, Types L.

2.5.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be

designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.5.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.4 Valves

2.5.4.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

2.5.4.2 Check Valve

Check valve 50 mm and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 100 mm and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.4.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 2070 kPa (300 psi). Valve shall be non-rising stem, all bronze, 90 degree angle type, with 65 mm (2-1/2 inch) American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 65 to 40 mm (2-1/2 to 1-1/2 inch) reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be polished brass.

2.5.4.4 Floor Control Valves

Provide floor control valves where indicated and install in accordance with Figure A-4-15.4.2(b) of NFPA 13 and provide a water pressure gage at each floor control valve. UL floor control assemblies will be acceptable.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

Mechanically operated, exterior-mounted, water motor alarm assembly shall be provided and installed in accordance with NFPA 13. Water motor alarm assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 20 mm galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 25 mm galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 38 L/min or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 15 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa . There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa . The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting or flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be

used in accordance with their listed coverage limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

2.10.1 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed quick-response type with nominal 12.7 mm or 13.5 mm orifice. Pendent sprinklers shall have a white polyester enamel finish.

2.10.2 Upright Sprinkler

Upright sprinkler shall be chrome-plated quick-response type and shall have a nominal 12.7 mm or 13.5 mm orifice.

2.10.3 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 12.7 mm orifice. Sidewall sprinkler shall have a brass finish. Sidewall sprinkler shall be the quick-response type.

2.10.4 Residential Sprinkler

Residential sprinkler shall be installed within all dwelling units and Barracks lobby and Barracks corridor only. Residential sprinkler shall be the pendent recessed type with nominal 12.7 mm orifice. Residential sprinkler shall have a white enamel finish.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 20 mm and suitable for installation on pendent sprinklers. The escutcheon shall

have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located in areas where daily operations significantly increase the risk of mechanical sprinkler damage.

2.12.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide x 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 FIRE HOSE REEL ASSEMBLY

Assembly shall include nozzle, fire hose, reel, 40 mm valve, and bracket suitable for wall mounting. The assembly shall be semi-automatic type complete with Underwriters clip which permits controlled one-man operation whereby control valve can be opened, hose unreeled and clip released by pulling on hose. Valve shall be non-rising stem, all bronze, angle type with 40 mm American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Reel shall be of steel construction with red enamel finish and shall be equipped with 30 meters of 40 mm rubber lined fire hose. Nozzle shall be of the industrial combination fog-straight stream type with shutoff. Components of the assembly shall be listed in UL Fire Prot Dir.

2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 1034 kPa. The maximum pressure loss shall be 40 kPa at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

2.15 BACKFLOW PREVENTOR TEST CONNECTION

Provide downstream of the backflow prevention assembly listed hose valves

with 65 mm (2 1/2 inch) National Standard male hose threads with cap and chain. Provide one valve for each 960 LPM (250 gpm) of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Sign" which reads, "Test Valve".

PART 3 EXECUTION

3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceed 9M.

3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm . Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm . Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site.

Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the

drawings for servicing or adjusting the joint.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm (.).

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840a FIRESTOPPING.

In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe connected to the remote branch line; a test valve located approximately 2 meters above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test."

The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 11 liters, the auxiliary drain shall consist of a valve not smaller than 15 mm and a plug or nipple and cap. When the capacity of trapped

sections of piping is more than 11 liters, the auxiliary drain shall consist of two 25 mm valves and one 50 x 300 mm condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 25 mm in diameter. Tie-in drain lines shall be pitched a minimum of 15 mm per 3 mm .

3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 900 mm above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 900 mm . The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm outside the building walls shall meet the requirements of Section 02510a WATER DISTRIBUTION SYSTEM.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315a EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are

successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 liters per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 65 mm diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final

Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

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SECTION 14210A
ELEVATORS, ELECTRIC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 176	(1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(1998e1) Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM A 666	(1999) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

ASME INTERNATIONAL (ASME)

ASME A17.1	(1998a) Safety Code for Elevators and Escalators
ASME A17.2.1	(1997a) Inspectors' Manual for Electric Elevators
ASME QEI-1	(1997) Standard for the Qualification of Elevator Inspectors

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and
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Facilities

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 795 (Basic) Uniform Federal Accessibility Standards

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.11 (1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE C62.45 (1992) IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC (1997) Uniform Building Code (3 Vol.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 252 (1999) Fire Tests of Door Assemblies

UNDERWRITERS LABORATORIES (UL)

UL 1449 (1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Elevator System

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, and points of interface with normal power fire alarm system and exhaust systems. Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operation and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices which are frequently different from National Electrical Code standard sizes.

SD-03 Product Data

Training Data

Information describing the training course for operating personnel, training aids and samples of training aids and samples of training materials to be used, training schedules, and notification of training.

Elevator System

A complete list of equipment and material, including illustrations, schedules, manufacturer's descriptive data and technical literature, performance charts, catalog cuts, installation instructions, brochures, diagrams, and other information required for fabrication and installation of the equipment. Data shall include calculations for reaction loads imposed on building by elevator systems. Calculations to demonstrate compliance with ASME A17.1, Rule XXIV, and to demonstrate that the proposed elevator system conforms to paragraph SEISMIC REQUIREMENTS; certified copies of test reports may be submitted on lieu of calculations. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than five weeks prior to date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended to be replaced and replacement interval required. Data shall include the appropriate sizing of electrical protective devices.

Framed Instructions

Diagrams, instructions, and other sheets, proposed for posting.

Test Procedures; G

A plan detailing the testing procedures shall be submitted 60 days prior to performing the elevator tests.

SD-04 Samples

Finishes

Samples of materials and products requiring color or finish selection.

SD-06 Test Reports

Testing

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system.

SD-07 Certificates

Qualification Certificates

Certificates of experience of elevator mechanics employed to install, supervise and test the elevator shall certify mechanics to have not less than 5 years experience installing, supervising and testing elevators of the type and rating specified. Certificate shall certify that elevator system installer is acceptable to elevator manufacturer, prior to installation of elevators.

SD-10 Operation and Maintenance Data

Elevator System; G

Six copies of operation manual outlining the step-by-step procedures for system startup, operation and shutdown. Manuals shall include manufacturer's name, model number, service manual parts list and brief description of all equipment, including basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manuals shall include equipment layout and complete wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

1.3 QUALIFICATIONS

Electric elevators shall be pre-engineered elevator systems, and provided by a company regularly engaged in the manufacture of elevator systems. The manufacturer shall either install the elevator system or provide letter of endorsement certifying that the elevator-system installer is acceptable to the manufacturer.

1.4 REGULATORY REQUIREMENTS

Design and fabrication shall be in accordance with ASME A17.1. Each car

shall have the capacity to lift a live load, exclusive of the car and cable at a speed as specified in the following schedule. The approximate travel, terminal floors, number of stops and openings, and the car sizes shall be as shown in the schedule. The elevators shall serve the floors with stops and openings in accordance with the requirements indicated. Passenger and Service elevators shall provide accessibility and usability for physically handicapped in accordance with the requirements for the handicapped in FED-STD 795 and 36 CFR 1191.

1.4.1 Elevator Schedule (Passenger) - Barracks Building "BK-3" and "BK-4"

Number of Elevators Required:	1 for each building.
Type:	Geared.
Service:	Passenger.
Capacity:	1587 kg (3500 pounds).
Speed:	1.78 m/s (350 fpm).
Platform Size:	2134 wide by (7'-0") wide by 1905 mm (6'-3") deep by 3099 mm (10'-2") high floor to dome.
Clear Car Inside:	2032 mm (6'-8") wide by 1651 mm (5'-5") deep by 2870 mm (9'-5") high floor to ceiling.
Net Travel:	13,840 mm (45' -5").
Landings:	5.
Openings: Front	5.
Openings: Rear	0.
Entrance Type:	Center-opening horizontal sliding.

1.4.2 Elevator Schedule (Passenger/Service)- Barracks Buildings "BK-3" and "BK-4")

Number of Elevators Required:	1 for each building.
Type:	Geared.
Service:	Passenger/Service.
Capacity:	2268 kg (5000 pounds)

Speed:	1.78 m/s (350 fpm)
Platform Size:	1829 mm (6'-0") wide by 2858 mm (9'-4-1/2") deep by 3099 mm (10'-2") high floor to dome.
Clear Car Inside:	1727 mm (5'-8") wide by 2565 mm (8'-5") deep by 2870 mm (9'-5") high floor to ceiling.
Net Travel:	13,840 mm (45'-5").
Landings:	5.
Openings: Front	5.
Openings: Rear	0.
Entrance Type:	2-speed horizontal sliding.

1.5 DESIGNATED LANDING

For the purposes of firefighter's service and emergency operations, as required by Section 211, ASME A17.1, the designated landing or level shall be the first floor. The alternate landing or level shall be the second floor.

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variations; and dirt, or other contaminants.

1.7 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work.

1.8 WARRANTY

Warranty service shall be provided for each elevator for a period of 12 months after date of acceptance by Contracting Officer. Warranty service shall be performed only by trained elevator mechanics during regular working hours, and shall include manufacturer's warranty requirements including but not limited to adjusting, labor and parts needed to keep the elevator in proper operation. Testing and adjustments shall be in accordance with the applicable provisions of ASME A17.1 and ASME A17.2.1. Emergency callback service shall be included and available 24 hours a day, 7 days per week, with an initial telephone response time of two hour and a response time of 4 hours for a mechanic to the site. Inspection and

service for fire service operation shall be performed every 6 months. Documentation of inspection and testing, and certification of successful operation shall be provided with each visit.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the fabrication of elevators and/or elevator parts, and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is available 24 hours a day, 7 days per week, with a response time of 4 hours.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, and electrical and mechanical characteristics on a plate secured to the item of equipment.

2.1.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.1.4 Electrical Work

Changes to the electrical distribution system required for coordination with elevator equipment shall be performed and coordinated by the Contractor, at Contractor's expense. Electrical service for elevator machines shall be 460 volt, 60-Hertz, 3-phase, alternating current. The elevator machine feeder for each elevator shall have a circuit breaker or fused disconnect switch located in the elevator machine room, and shall terminate at the control panel for that elevator. Electrical work shall conform to requirements in Section 16415A ELECTRICAL WORK, INTERIOR. A feeder with circuit breaker or fused disconnect switch located in the elevator machine room, shall be terminated at the control panel for each elevator. A telephone junction box and an elevator car lighting junction box shall be provided adjacent to each controller. A single-phase electrical circuit with grounded connection for video monitor shall be provided in machine room. A disconnect switch that will shutoff power to the elevator car lighting shall be provided in the elevator machine room adjacent to the elevator control panel.

2.1.5 Use of Asbestos Products

Materials and products required for manufacturing and installing elevators shall not contain asbestos.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Materials for Car Enclosures

Materials for car enclosures shall meet flame spread rating 0 to 75 and smoke development 0 to 450 as tested in accordance with requirements of ASTM E 84 and as established by ASME A17.1, Rule 204.2.

2.2.2 Structural Steel

Structural steel shall be hot-rolled commercial quality carbon steel, pickled, oiled, complying with ASTM A 569/A 569M and ASTM A 568/A 568M.

2.2.3 Cold-Rolled Sheet Steel

Sheet steel shall be cold-rolled commercial quality low-carbon steel, Class 1, exposed matte finish, oiled, complying with ASTM A 366/A 366M and ASTM A 568/A 568M.

2.2.4 Stainless Steel

Stainless steel shall be ASTM A 176 Type 302/304, austenitic, corrosion-resistant with grain of belting in direction of longest dimension. Surfaces shall be smooth and without waves and shall be in compliance with ASTM A 666 and ASTM A 568/A 568M.

2.3 PASSENGER ELEVATOR CAR

2.3.1 Car Fronts

Fronts for passenger elevators shall be combination door post and return panels manufactured of 1.9837 mm thick (14 gauge) stainless steel provided with necessary cutouts for operating devices. Operating panel shall be recessed into front return panel with surface-applied operating panel cover. Position indicator in front return shall be recessed with a surface-applied cover plate. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.3.2 Car Doors

Car doors for passenger elevators shall be constructed from 1.519 mm thick (16 gauge) sheet steel and stainless steel cladding. Each door shall be sound-deadened and reinforced to receive required operating mechanism and hardware, and have two removable door guides per panel. Seams, screws or binding strips shall not be visible from within the car. Threshold shall be extruded aluminum with grooves for door guides. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected. Car doors shall be equipped with a proximity-type infrared car door protective device having the following operation:

- a. When doors are in full-open position, doors shall be unable to initiate closing if a person comes within the detection zone. The detection zone moves with the doors, so that if a person or object enters the zone after the doors have begun to close, the doors shall stop, then reverse to reopen. The doors shall reclose after a brief time. A passenger entering or leaving the cars shall not

cause the doors to reopen unless the doors reach a predetermined proximity to the passenger.

- b. After a stop is made, the doors shall remain open for a time to permit passenger transfer, after which they shall close automatically. This time interval shall be less for a car call than for a hall call or a coincident car/hall call.
- c. If there is either a hall call anywhere in the group or a car call in the car in question and the doors are prevented from closing for a fixed time period, the door protective device shall be rendered inoperative, a buzzer shall sound in the car and the doors shall close at approximately half speed. Normal door operation shall resume at the next landing reached by the car.

2.3.3 Car Platform

Car platform for passenger elevators shall be fabricated from steel plates secured to a steel frame or plywood secured to a steel frame. Steel car platforms shall be assembled into a one-piece platform with top and bottom steel plates welded to structural steel frame and covered with felt and sound-isolation. Plywood car platform shall be 18 mm (3/4 inch) thick Exposure 1 plywood secured to structural steel frame with metal fire protection secured to underside of structural steel frame.

2.3.4 Walls

Walls for passenger elevators shall be 2870 mm (9 feet 5 inches) high from floor to the underside of lighting fixtures. Side and rear panels shall be 1.519 mm thick (16 gauge) sheet steel panels. Lower portion of side and rear wall panels shall be provided with a 2.7788 mm thick (12 gauge) stainless steel wainscoting from top of car base to a point 50 mm (2 inches) above top of handrail. Vent around base shall be provided.

2.3.5 Car Top, Ceiling and Light Fixtures

Car top for passenger elevators shall be manufactured from 2.657 mm thick (12 gauge) sheet steel and shall be not less than 140 mm high with drop-ceiling and light fixtures. Ceiling shall be 3 mm (1/8 inch) thick translucent white plastic fire-retardant light diffuser supported by baked enamel perimeter frame and dividers to form the drop-ceiling light fixture. Light fixtures shall be fluorescent type, flush with car ceiling, manufactured of sheet steel with flange and enclosed sides and top, baked-enamel reflector, mounted directly to outlet box. Bottom of fixtures shall be flush with car ceiling. Fluorescent light fixtures shall be dual lamp with quick-starting high-power factor, Class P ballasts, with safety lamp guard clamps on fluorescent tubes. Light level shall average at least 108 lx (10 footcandles) measured at the car threshold with the door closed. Part of car light fixture shall be removable to permit use of the emergency exit in top of car.

2.3.6 Emergency Exit

Car top for passenger elevators shall be manufactured with a hinged

emergency exit panel of 2.657 mm thick (12 gauge) steel which opens up to clear the crosshead and car door operator. Emergency exit panel shall be hinged and held in place with nonremovable fastening devices at each corner, and manually openable from top of car and key-operable from inside.

A minimum of 2 sides of exit panel shall lap the exit opening by 25 mm. Exits shall be equipped with electrical contacts which will prevent operation of car when exit door is open and cause the alarm bell to ring.

2.3.7 Floor Finish

Floor finish for passenger elevators shall be finished with resilient tile flooring not less than 5 mm (3/16 inch) thick or flexible-type homogeneous vinyl tile not less than 3 mm (1/8 inch) thick as specified in Section 09650 RESILIENT FLOORING. Tile shall be laid flush with the extruded aluminum platform threshold.

2.3.8 Base

Base for passenger elevators shall be cove type stainless steel, 150 mm (6 inches) high.

2.3.9 Handrails

Handrails for passenger elevators shall be mounted on each wall and shall comply with ASME A17.1, FED-STD 795 and 36 CFR 1191. For elevators with 2-speed horizontal-slide openings the handrails shall be turned back to wall.

2.3.10 Exhaust Fan

Exhaust fan for passenger elevators shall be 2-speed exhaust type ventilating unit mounted in car ceiling and shall be provided with a stainless steel grille. Units shall be suitably isolated from car ceiling and shall provide at top speed a minimum of 6 air changes per hour for car volume and car occupancy. Switches for the operation of exhaust unit shall be located in car station locked cabinet or key-switched.

2.3.11 Communications

A telephone system in stainless steel cabinet shall be provided for passenger elevators. A vandal-resistant speaker type intercom with push-button to activate shall be installed in car station behind a stainless steel perforated grille and connected to a programmable auto-dialer located in machine room. Auto-dialer shall be provided with a solid-state charger unit which will automatically provide emergency power and an immediate transfer in the event of failure of normal power supply. The push-button located in the car station or in separate cabinet shall be at the prescribed handicapped height and shall be identified as "Emergency Phone (Push to Activate)". The entire communication assembly shall be approved for an elevator installation. The telephone communication shall not be terminated until one of the communicating parties hangs up the receiver or manually disconnects the communications link.

2.3.12 Car Emergency Lighting System

Emergency car lighting system for passenger elevators shall consist of an emergency power pack on top of elevator and a remote lighting fixture inside elevator car located in car operating panel.

2.3.12.1 Power Pack

Power pack for car emergency lighting system shall be sealed lead-cadmium or nickel-cadmium 6-volt rechargeable batteries with solid-state controls and an integral regulating charger connected to normal power supply. Power pack unit shall contain the following:

- a. Minimum 150 mm (6 inch) diameter alarm bell connected to the elevator alarm and emergency push-button.
- b. Top of car light fixture with protective wire guard.
- c. Testing circuit and pilot light.
- d. Low-wattage pilot light indicator.
- e. Battery low-voltage disconnect.

2.3.12.2 Emergency Light Fixture

Emergency light fixture for passenger elevators shall be located in car station inside elevator car, with flush-mounted lens and shall consist of the following:

- a. A minimum of two lamps capable of providing a minimum level of illumination of 10.8 lx (1.0 footcandle) at a point 1220 mm (4 feet) above the floor, 300 mm (1 foot) in front of car station.
- b. Fixture frame of steel with baked-enamel finish.
- c. Frosted acrylic lenses, 6 mm (1/4 inch) thick.

2.3.12.3 Remote Light Fixture

Upon interruption of normal power, remote light fixture for passenger elevators shall automatically and immediately illuminate and permit operation of the bell, subject to the activation of the emergency stop-switch or alarm button. Emergency power pack shall be capable of providing a minimum of 1 hour emergency bell operation and 4 hours of continuous illumination.

2.3.13 Protection Pads

All passenger elevator cars shall be provided with wall protection pads, with inconspicuous stainless steel pad hooks spaced not over 460 mm apart near ceiling. Pads shall be heavy quality fire-retardant treated canvas with two layers of sewn cotton batting with metal eyelets for each pad hook. Pads shall cover the entire wall surface except operating devices. Pads shall be flame retardant in accordance with ASME A17.1 (Rule 204.2).

2.3.14 Certificate Frame

A stainless steel certificate frame with translucent plexiglass lens of the appropriate size to receive certificate issued by inspecting agency shall be provided for passenger elevators. Frame shall be engraved to show name of elevator manufacturer, carrying capacity in kilograms (pounds) and maximum number of persons allowed.

2.3.15 Car and Counterweight Guides and Guide Shoes

Roller guides shall consist of minimum 3 tires mounted on top and bottom of car and counterweight frame. Roller guides shall be held in contact with guide rail by adjustable devices and shall run on dry, unlubricated rails.

2.3.16 Car Guide Rails

Guide rails for passenger elevator shall be planed steel tee or omega shaped sections with structural channel rail backing as required, tongue-and-groove matched joints reinforced with fitted splice plates. Guide rails shall extend from bottom of pit to underside of roof over hoistway.

2.4 PASSENGER ELEVATOR HOISTWAY ENTRANCES

2.4.1 Hoistway Doors

Hoistway doors for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Door panels shall be hollow metal type with plain panel design, not less than 32 mm (1-1/4 inches) thick with 1.519 mm thick (16 gauge) face sheet-steel and stainless steel cladding with 1.519 mm thick (16 gauge) sight guards. Each door shall be reinforced with continuous vertical members and filled with sound-deadening material. Doors shall be reinforced to accept the required operating mechanism and hardware. Doors shall have 2 removable door guides per panel. Seams, binding strips or screws shall not be visible from landing. Exposed steel shall be finished rust-inhibitive primer and baked-enamel in color to be selected, unless otherwise specified.

2.4.2 Hoistway Frames

Hoistway frames for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Frames for passenger elevators shall be formed 1.897 mm thick (14 gauge) sheet-steel with head and jamb in flush alignment and corners welded and ground smooth. Head and jamb section shall be bolted assembly with bolts, washer and locking nut or lock washer. Frame assembly shall be securely fastened to structure. Frames shall return to wall. Combination buck and jamb frames may be provided with knockdown back flanges to permit installation in concrete walls. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless

otherwise specified.

2.4.3 Symbols

Raised stainless steel symbols as required by FED-STD 795 and 36 CFR 1191 of color selected, shall be provided for passenger elevators at each floor to indicate the floor location. Symbols shall be attached with concealed fasteners. Symbols shall be placed in a location which can be seen by passengers from the opened passenger doors.

2.4.4 Sills

Sills for passenger elevators shall be extruded aluminum with slip-resistant surface and machined grooves for door guides, secured to floor beams.

2.4.5 Strut Angles

Strut angles for passenger elevators shall be structural steel of size not less than 76 x 76 x 5 mm (3 x 3 x 3/16 inch) extending from sill to beam above and anchored to building structure with structural steel fastenings and bracings of structural members with a cross section of not less than strut angles.

2.4.6 Door Hangers and Housing

Each door panel shall be provided with not less than 2 sheave-type hangers designed for required door operation. Hanger housing and support shall be fabricated from formed Z-shaped steel angles of size not less than 5 mm (3/16 inch) thick bolted to strut angles.

2.4.7 Door Rollers

Door rollers shall be constructed with grease-packed ball-bearings and shall be tired with a sound-reducing material. Diameter of rollers shall be not less than 83 mm (3-1/4 inches) for car doors and not less than 57 mm (2-1/4 inches) for hoistway doors. Upward thrust shall be taken by a hardened and ground ball-bearing roller assembled on an eccentric stud to provide adjustment.

2.4.8 Hanger Track

Hanger track shall be of high carbon cold-drawn steel, round at top to receive door rollers, and round at bottom to receive up-thrust rollers, of size engineered to accommodate load requirements.

2.4.9 Covers and Guards

Hanger covers, dust covers, toe guards, and fascia plate shall be fabricated from 1.579 mm thick (16 gauge) reinforced steel and finished with baked-enamel. Hanger covers shall extend the full door travel and shall be mounted in sections for ease of servicing door hangers. Dust covers shall be provided over top terminal landing door only and shall be secured to hanger housing and building structure. Toe guards shall be

secured to sill. Fascia plates shall be provided between each door hanger housing and sill.

2.5 PASSENGER ELEVATOR DOOR OPERATION

Car and hoistway doors for passenger elevators shall be operated simultaneously by an electric door operator. Doors shall operate smoothly in the opening direction and closing direction and be electrically or hydraulically cushioned to stop at both the full-open and full-closed position. Operators shall be high speed direct current, heavy-duty type providing an average door opening speed of 0.76 m/s (2-1/2 feet per second).

Car and hoistway doors shall be opened and closed simultaneously in a maximum time of 2.7 seconds. When on automatic operation the door closing time shall not exceed 4.5 seconds and door closing force shall not exceed 130 N (30 pounds). Reversal of the doors when closing shall be accomplished by the "DOOR OPEN" button, car door safety edge, or interception of the photoelectric light beams. Doors shall be arranged so that doors can be opened manually in the event of power failure.

2.6 PASSENGER ELEVATOR OPERATING AND SIGNAL FIXTURES

2.6.1 General

Elevator fixtures and panels for passenger elevators shall be constructed of 3 mm (1/8 inch) thick faceplates of stainless steel. Fastenings for all exposed fixtures shall be secured with tamper-proof spanner-head screws of same material and finish as fixture. Hall and car-call buttons shall be of the call register type with a low-voltage power supply not to exceed 48 volts. Pressure on a button shall illuminate button to indicate that a call in the desired direction has been registered. Car and hall fixtures shall be designed and located at the prescribed height to accommodate the handicapped in accordance with FED-STD 795 and 36 CFR 1191 for passenger elevators only. Handicapped markings shall be integral with faceplate in accordance with FED-STD 795 and 36 CFR 1191. Surface-applied markings are unacceptable. Engraving shall be black filled except for fire service identification which shall be red filled. Operating and signal fixture contacts and lamps shall be completely enclosed in steel boxes finished with baked-enamel. Boxes for hall landing devices shall be equipped for proper adjustment to wall. Lamps shall be installed in light-tight compartments. Cover plates shall be provided with rubber gaskets when exposed to weather or harmful contaminants. Replacement bulbs shall be readily available from 3 sources.

2.6.2 Car Operating Panel

Car operating panel for passenger elevators shall be provided with the necessary raised (0.8 mm (0.03 inch)) markings for the handicapped, and shall include a series of minimum 20 mm (3/4 inch) diameter or square push-buttons numbered to correspond to the floor served and various additional switches, buttons and light jewels, including emergency stop, alarm button, "DOOR OPEN" button and communication speaker. Operating buttons shall be vandal-resistant metal encased and embossed to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm (1/32 inch) operating clearance to seat on faceplate in lieu of the

button mechanism. Buttons shall have maximum protrusion of 5 mm (3/16 inch)

beyond the faceplate and shall have beveled edges to prevent damage from side blows. Buttons and switches not required for automatic or fire service operation shall be key-operated and mounted on front-return car operating station. Elevator number and "NO SMOKING" shall be international symbol engraved on upper portion of car station. Operating panel in the car shall consist of a flush-mounted panel containing the following operating devices:

- a. "DOOR OPEN" button.
- b. "DOOR CLOSE" button.
- c. Key-operated car fan/light switch.
- d. Key-operated ventilating blower switch/call-light.
- e. Communication speaker phone, grille and push-to-call button.
- f. Emergency stop switch behind locked cover when operated will stop the car independently of normal stopping devices. Operation of emergency stop switch shall not cause any power variance or surge that may affect the operation or condition of the control panel or its components.
- g. Emergency signal-switch connected to a 150 mm (6 inch) diameter signal bell outside of elevator hoistway at first floor located as shown or as directed.
- h. Key-operated independent operation switch (for multi-car only).
- i. Key-operated inspection switch which will render normal operation inoperative for the purpose of using the hoistway access switch.
- j. Key-operated fire service switch and light jewel.
- k. Key-operated hospital emergency switch.

2.6.3 Auxiliary Car Operating Panel

Auxiliary car operating panel for passenger elevators shall be similar in design to main car panel, and shall include all devices necessary for automatic operation, such as emergency stop switch, alarm bell, door open button, and call car buttons.

2.6.4 Hall-Call Station

Hall-call operating devices for passenger elevators at landing shall consist of an "UP" push-button at bottom landing, a "DOWN" push-button at top landing and "UP" and "DOWN" push-buttons at all other landings. Push-buttons shall be vandal-resistant, metal encased and back-lighted to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm (1/32 inch) operating clearance to seat on faceplate in lieu of the button mechanism. Buttons shall have maximum protrusion of 5 mm

(3/16 inch) beyond the faceplate with beveled edges to prevent damage from side blows.

2.6.4.1 Commandeering Switch

Key-operated commandeering switch for passenger elevators shall be provided at each landing and located in landing call-button cover plate. Switch shall be momentary pressure type with the key removable only in "OFF" position and shall be keyed to match the independent operation switch specified for car operating devices.

2.6.4.2 Fire Service Switch

Fire service switch for passenger elevators shall be located at the designated landing.

2.6.5 Direction Lanterns

Lanterns for passenger elevators shall be in accordance with FED-STD 795 and 36 CFR 1191, and shall be provided at all floor landings and in each car entrance column. Lanterns shall be vandal-resistant design.

2.6.6 In-Car Position Indicator

Indicator numerals and directional arrows for passenger elevators shall be flush-mounted faceplate with black-filled engraved numerals not less than 25 mm (1 inch) high and 10 mm (3/8 inch) diameter vandal-resistant light jewels directly beneath each number. As car travels through hoistway the car position shall be indicated by illumination of light jewel corresponding to landing at which the car is stopped or passing. Necessary light baffles shall be provided. Floor numerals and letters shall illuminate white. A position indicator of the digital-readout or dot-matrix type (minimum 50 mm (2 inch) high indication) shall be provided in car transom panel. Number corresponding to car position shall remain illuminated when motor drive is shut down. Illumination shall be shrouded in an approved manner to protect against glare from car lighting.

2.6.7 Audible Signals

An audible sign shall be provided at each floor landing and in each car and shall sound coincident with the lantern illumination indicator. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. The audible signal shall sound once for UP direction and twice for DOWN direction.

2.6.8 Combination Hall-Position Indicator and Directional Arrows

Combination hall-position indicator and directional arrows for passenger elevators shall be provided at first floor landing directly over entrance frame. As elevator travels in hoistway, elevator position shall be indicated by illumination in alpha-numeric characters corresponding to the landing where elevator is stopped or passing. Number corresponding to position of car shall remain illuminated when the motor drive is shut down. An audible signal shall sound in the elevator car to indicate that the

elevator car is stopping or passing a floor served by elevator. Fixture design and operation shall be similar in design to that specified for Car Position Indicator.

2.7 PASSENGER CAR OPERATION (DUPLEX SELECTIVE/COLLECTIVE)

Passenger Elevators No. 1 and 2: Cars shall be arranged so that when all calls have been answered, one car will park at the main entrance floor, the other car will remain at last floor served. A car at first floor or traveling UP shall continue UP until all UP landing calls are answered provided the landing buttons are pressed in time to make the stop and shall answer all DOWN landing calls behind the other car traveling DOWN. A car at the top floor traveling DOWN shall continue DOWN until all DOWN landing calls are answered provided the landing buttons are pressed in time to make the stop and shall answer all UP landing calls behind the other car traveling UP. When both cars are in operation, landing calls shall be answered by the car nearest the call and set in the direction of call. Only one car shall answer any one landing call. Operation of each car shall be such that the momentary pressing of one or more car buttons shall close the car doors in an adjustable, predetermined time after the buttons are pressed and start the car. Cars shall stop at all landings for which car or landing buttons have been pressed in the order in which the landings are reached, irrespective of the sequence in which the buttons have been pressed. If one car is out of service or fails to start, the other car shall automatically answer all calls. When cars are parked at home landing with doors closed, pressing a hall button at those floors shall illuminate lights and shall open the car doors.

2.8 AUTOMATIC ELEVATOR OPERATION

2.8.1 General

The operating device shall consist of a series of push-buttons in car numbered to correspond to various landings, "UP" and "DOWN" buttons at intermediate landings, and a single button at terminal landing. To meet the elevator operation requirements specified in this section, all buttons shall be connected electrically to the control system which governs the floor selection, car selection, direction of travel and governs the acceleration and retardation.

2.8.2 Operation

Car calls shall be registered within the car by pressing the button corresponding to the designated floors. Hall calls shall be registered by pressing buttons in the corridor push-button fixture. Once the demand for elevator service has been established and the car has received a start signal the car operation shall be as follows.

2.8.2.1 Door Closing

Doors shall close automatically. When doors are fully closed and the interlock circuit established, the car shall start to move in the direction established by control system. Car shall accelerate and decelerate automatically and stop at first floor for which a car button has been

registered or at the first floor for a corridor demand which has been assigned to car. Car shall stop at all floors for which car calls are registered in the order in which the floors are reached and shall stop for any corridor demands assigned to the cars in the order in which the floors are reached.

2.8.2.2 Door Opening

Doors shall open automatically as car reaches the landing. After a predetermined time the doors shall close and the car shall proceed to answer the remaining car or assigned corridor calls. A protective device such as a safety edge and light beam device shall be provided on car door and when activated will prevent closing of doors. Cars shall become available for assignment at whatever floor the last car demand has been satisfied in the direction in which car is traveling.

2.8.2.3 Car Dispatch

When car does not receive a demand dispatch at dispatching floor for an adjustable time period up to 10 minutes set initially at 5 minutes, the motor drive unit shall be switched off. If the car's switched-off motor drive unit receives a demand dispatch the motor drive unit shall automatically restart.

2.8.2.4 Door Dwell-Time

Door open dwell-times shall be adjustable so that the open time for a car call is shorter than the open time for corridor calls and second passengers. If a longer time is needed for passenger entry, doors can be prevented from closing or reversing by the light beam door control, the protective leading edge on car door, or by pressing "DOOR OPEN" button in car. Door dwell-times shall comply with FED-STD 795 and 36 CFR 1191.

2.8.3 Independent Service

Freight elevators shall be arranged for independent service operation with a key-switch located in the locked section of car operating panel. When the car key-switch is placed in the "ON" position the key-switch shall remove car from corridor button operation to permit operation from car-buttons only. Elevator direction lanterns shall be inoperative when elevator is in this mode of operation.

2.8.4 Automatic Load Weighing

Passenger elevators shall be provided with load-weighing devices which will cause elevator to bypass hall calls when elevator is filled to an adjustable percentage. Corridor calls shall remain registered until the next available car responds to the call.

2.8.5 Anti-Nuisance

Passenger elevators shall be provided with a system which will cancel all car calls in the event that between 3 and 5 times the number of car calls are registered as there are passengers in car, allowing 70 kg per

passenger.

2.8.6 Door Operation

Double-door operation shall not be permitted for passenger elevators. If an UP traveling car has a passenger for an intermediate floor and a DOWN call is registered at that floor with no-calls above car, the car shall travel to floor, open the door and let passenger out, then light the DOWN direction arrow in hall lantern and accept the waiting passenger who registered the DOWN call. Doors shall not perform the open-close cycle before elevator proceeds to next call.

2.8.7 Automatic Power Shutdown Upon Fire Sprinkler Activation

Automatic power shutdown of the elevators will be initiated by a waterflow switch supervising sprinklers located in the elevator machine room or in the elevator hoistway.

2.9 FIREFIGHTERS' SERVICE

Firefighter service shall be in accordance with ASME A17.1 for automatic elevators. Elevator lobby and machine room smoke detectors shall be photoelectric or ionization spot-type smoke detectors. Smoke detectors shall be powered from to the building fire alarm control panel. Elevator lobby and machine room smoke detectors shall be in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

2.10 ELEVATOR MACHINE (GEARED)

2.10.1 Hoisting Machine

Machine shall be worm-gear traction type with motor, brake, worm gearing, traction sheave and bearings mounted on common bed plate. Worm shall be of steel and integral with the worm shaft and shall be provided with a ball-thrust bearing with self-alignment blocks or preloaded thrust bearing designed to take the end thrust of the worm in both directions. Main gear shall be hobbled from a bronze rim accurately fitted and bolted to gear spider. Gears shall be fitted to minimize the noise, vibration and wear. Roller bearings shall be complete with drive sheave shaft and provisions for lubrication. Design and construction of equipment and parts subject to wear shall be completely repairable and replaceable.

2.10.2 Hoisting Ropes

Hoisting ropes shall be the independent wire-rope type, regular lay, preformed, non-coated, improved plow steel of 6 x 37 construction. Hoisting ropes shall be suited for service requirements to be provided. Hoisting rope connections shall be by tapered babbitted socket connections and shall be rated in strength equal to or greater than the strength rating of the rope. Hoisting ropes shall be selected so that the rated capacity load plus the load block weight divided by the number of parts of rope will not exceed 20 percent of certified breaking strength of rope. Hoisting ropes shall be secured to the hoist drum so that no less than two wraps of rope remain at each anchorage of hoist drum at extreme low position.

2.10.3 Sheaves

Drive sheave shall be steel or semi-steel finished with grooves to receive hoist ropes and shall give maximum traction and minimum wear. Grooved nonmetallic inserts on drive sheave may be provided at Contractor's option.

Deflector and overhead sheaves, suitable sheet metal guards with required service openings, sheave beams and supports shall be provided as required.

2.10.4 Hoist Motor (Geared)

Motor shall be a geared type, direct-current for variable voltage with Class B insulation, designed for elevator service to develop the required high-starting torque with low-starting current in accordance with NEMA MG 1.

Motor shall be designed to meet requirements of elevator service and be capable of starting cold and carrying the full-rated load in car for a period of 1 hour of continuous UP and DOWN runs, stopping at all floors and standing not more than 10 seconds at each floor without overheating. Speed regulation of the car, with full-rated load shall not exceed plus or minus 5 percent of average on a round trip.

2.10.5 Armature

Armature shall be electrically balanced and the armature and brake drum shall be mechanically balanced as a unit. Field coils shall be spool or form wound. Windings in both armature and field shall permit easy removal.

2.10.6 Commutator

Commutator and brushes shall be of sufficient size, area and designed to perform under full-load with sparks barely visible and without overheating.

Brushes shall have individual tension adjustment with provisions for adjusting and positively locking the brush holder in place as a unit.

2.10.7 Brake Assembly

Brake shall be spring-applied, electrically released and designed for automatic application in the event of interruption of power supply. Brake drum shall have a wearing surface and edge of flange turned smooth and wearing surface shall run within a maximum variation of 0.13 mm (0.005 inches). Brake shoes shall be lined with a fireproof friction material shaped to shoes so that the drum will run free with normal clearance. Brake springs shall be helical and operated in compression and shall apply the brake when released by the magnet. Brake magnet shall be designed to release quickly. The brake application shall be automatically controlled by magnetic retardation to obtain noiseless, smooth and gradual stops under all loading conditions. Release magnet coil circuit shall be opened by the various safety devices, power failure, failure of equipment to function in the proper manner for safe operation of car and upon normal stopping of the car.

2.10.8 Bed Plate

Bed plate shall be cast iron or steel in one piece with stiffening ribs to

accurately maintain alignment of parts or be heavy rigid structural steel shapes securely welded together. Pads accurately planed or milled shall be provided as seats for parts secured to bed plate.

2.11 VARIABLE VOLTAGE CONTROL

2.11.1 Performance

Control system shall govern the starting, stopping and direction of travel of elevator and provide the operation specified. Control shall be accomplished by an individual generator or solid-state motor control for each elevator where the voltage applied to hoist motor is variable. Control equipment shall be of type suitable for motors and type of operation specified to provide smooth acceleration from stop to full speed, deceleration and landing stops under any load condition from no load to full-rated load. Maximum time from start of car motion to floor level at the next floor for geared machines shall be 2 seconds for a speed of 1.78 m/s (350 feet per minute. Time from door close to start of car motion shall not exceed 0.7 second with a balanced load. Cycle time, which is the time from start of door close to door fully open at the next typical floor, shall not exceed 10 seconds for geared elevators with a speed of 1.78 m/s per feet per minute. Prior to the termination of maintenance period included in the Base Contract, elevators shall be readjusted as required to meet performance requirements. All performance times specified in this section are based on 3.46 m (11 feet 4 inches) floor height, and 1067 mm (3 feet 6 inches) wide center-opening passenger elevator door and 1219 mm (4 feet 0 inches) wide two-speed slide passenger/service elevator doors.

2.11.2 Controller

Electric controller shall be microprocessor-based logic type with battery backup system with charger and charge time for a depleted battery, battery reserve and a low-voltage disconnect. Components required for proper performance of elevator shall be neatly mounted and wired and completely enclosed in a cabinet with a mechanically-latched door.

2.11.3 Solid-State Motor-Control

A solid-state motor-control unit shall be provided for each elevator, with electrical characteristics suitable to the available distribution system. The system shall consist of necessary 3-phase, full-wave bridge rectifiers or other devices and shall be full regenerative. A Transient Voltage Surge Suppressor (TVSS) device shall be provided to protect the solid-state motor-control unit and other electronic equipment in the facility. Solid-State control unit shall have the capacity to handle peak currents and shall contain a balanced and coordinated fault-protection system to protect the unit as follows:

- a. Protection system shall protect complete power circuit (specifically the power semi-conductors) from failure under short circuit conditions.
- b. Protection system shall protect unit from faults arising from partial grounds, partial shorts in motor armature, or in power

unit.

- c. Protection system shall protect drive motor against sustained overloads using a solid-state overload circuit.
- d. Protection system shall protect motor and power unit against instantaneous peak overload.
- e. Protection system shall protect phase sequence to ensure incoming line is phased properly.
- f. Protection system shall protect unit against instantaneous overcurrent.
- g. Protection system shall protect unit against low power line voltage (less than 75 percent of nominal).
- h. Protection system shall protect unit against blown ac input fuse and blown dc converter output fuses.
- i. Protection system shall protect against excessive converter output voltage and excessive open-circuit voltage, and heat dissipation device.
- j. The Transient Voltage Surge Suppressor (TVSS) device used to protect the solid-state motor-control unit shall be listed by UL 1449 and tested by manufacturer to meet requirements of IEEE C62.11, IEEE C62.41 and IEEE C62.45 Categories A, B and C. The system shall be connected in parallel with the protected system; series-connected elements which could constitute a single-point failure shall not be used. The protection modes for the TVSS device shall have as a minimum line-to-ground, neutral-to-ground, line-to-neutral and Delta Systems line-to-line. The TVSS surge current capacity, based on an 8 x 20 micro-second waveform, shall be a minimum of 75K amps per phase. The maximum UL 1449 clamping voltage for each protection mode shall not exceed 800 volts for 208, 240 and 277/480 volt system. The TVSS system shall provide a joule rating that meets or exceeds the requirements of IEEE C62.41 Category C delivery capability. The TVSS system shall provide a noise-attenuation of 40 db for electrical line noise. The TVSS system shall be a symmetrically balanced metal oxide varistor (MOV) array system, constructed with surge current diversion modules each capable of withstanding 25 KVA surge current based on standard 8 x 20 micro-second waveform. Each module shall be capable of withstanding over 1000 pulses of 10K amps in accordance with IEEE C62.41 Category C surge current without degradation of clamping voltage. The module shall consist of multiple gapless metal oxide varistor individually fused. Gas tubes or silicon avalanche shall not be used. When module performance is degraded, as if one or more fuses or varistors have failed, a light emitting diode (LED) indicator shall indicate a failed module.

2.11.3.1 Fault Conditions

Occurrence of any of the above fault conditions shall result in the immediate removal of the drive's run command, the clamping of the internal current regulator, the opening of armature loop and an emergency dynamic brake stop. Drive system shall also notify the car controller of shutdown via a drive status signal. Car controller shall respond to continuous-drive reset pulses which shall reset the drive as soon as fault condition clears, if it is not a hard failure such as blow fuse, and shall return elevator to service. The dc direct-drive system shall be designed to include input impedance to filter out electro-mechanical noise on SCR drive system.

2.12 SENSOR AND CONTROL WIRING SURGE PROTECTION

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected, as shown against surges induced on control and sensor wiring installed outdoors. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.13 COMMUNICATIONS LINKS SURGE PROTECTION

Communications equipment shall be protected against surges induced on any communications link. Cables and conductors, except fiber optics, which serve as communications links from motor control room (MCR) to field equipment, and between field equipments shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.14 COMMUNICATIONS LINKS OVER VOLTAGE PROTECTION

Communications equipment such as MODEMs, line drivers, and repeaters shall be protected against overvoltage on communications link conductors. Cables and conductors, which serve as communications links, except fiber optics,

shall have overvoltage protection for voltages up to 480 Vac rms, 60 Hz installed. Instrument fuses or fusible resistors are required for this application.

2.15 COUNTERWEIGHT

Counterweight for each car shall equal the weight of car plus approximately 40 percent of specified load. Concrete weights are not acceptable. Counterweight screen of metal construction, at least 2 m high, shall be provided as a protective guard at bottom of hoistway, except where the type of hoisting rope compensation prevents this type of installation.

2.16 LEVELING DEVICES

Elevators shall be equipped with a 2-way leveling device to automatically bring the car to the floor landings. Car shall automatically relevel at each landing to correct overtravel and undertravel, and maintain the level regardless of load on the car, rope slippage or stretch of cables. Electric stopping system shall be arranged so the car will stop level with the floor before brake is set. Stopping accuracy shall not exceed plus or minus 6 mm.

2.17 BUFFERS

Buffers shall be of design suitable for depth of pit. Buffer anchorage at pit floors shall be provided for each car and counterweight and arranged to avoid puncturing of the pit waterproofing. Type of buffer used shall be tested and approved for compliance with elevator service requirements. Pipe struts and steadiers shall be provided as required by pit conditions. A metal plate with information concerning stroke and load-rating shall be permanently fastened to each buffer. Pit-mounted buffers shall have an adequate stroke designed to bring the fully-loaded car and counterweight to rest from governor tripping speed at an average rate of retardation not exceeding gravity. Moving portion of buffer shall be designed to be accelerated by the car without a noticeable peak retardation. Oil buffers shall be of the spring-return type, except that counterweight buffers attached to counterweight may be the gravity-return type. Provisions shall be made for checking oil level. Switches shall be provided for spring-return oil buffers.

2.18 LUBRICATION POINTS

Every part subject to movement friction shall be complete with provisions for oil and grease lubrication.

2.19 SEISMIC REQUIREMENTS

Seismic protection shall be provided in conformance with TI 809-04 for general guidance and computation of forces (1.0 G horizontal and 1.0 G vertical minimum), ASME A17.1, Rule XXIV, and ICBO UBC Building code. The Contractor shall hire a registered engineer to submit the stamped calculations and drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Elevators and equipment shall be installed in accordance with ASME A17.1 and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building framing as indicated and at intervals not exceeding 3460 mm. Steel plate shims shall not be used for aligning equipment. Guide rail sections shall be joined rail sections, joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation stainless steel surfaces shall be protected.

3.2 FIELD WELDING

When structural or load-bearing members are to be field-welded, welding and qualification of welders shall be as specified in Section 05120 STRUCTURAL STEEL.

3.3 ELEVATOR WIRING

Wiring shall be provided for electrically-operated items of elevator equipment to comply with requirements of NFPA 70 and Section 16415A ELECTRICAL WORK, INTERIOR. For control and signal circuits wire shall be minimum No. 18 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. A work light fixture equipped with 150 watt incandescent lamps and ground duplex receptacles shall be provided at both the top and bottom of the car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on controller. Intra-panel wiring shall be flame-resisting type.

3.3.1 Traveling Cables

Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.

3.4 PAINTING

Except for factory finished items and corrosion-resistant items, machined surfaces shall be painted as specified in Section 09900, PAINTING, GENERAL.

3.5 TESTING

Testing shall be in accordance with requirements of ASME A17.1 and ASME A17.2.1 and as specified below. Contractor shall conduct a complete test of the system. After the system has passed all tests, the Contractor shall notify the Contracting Officer in writing, 30 days prior to the time of performing the acceptance test, that the system is complete and is ready for final acceptance testing. The Contractor after receiving written approval from the Contracting Officer will conduct a complete acceptance

test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the acceptance testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall be certified in accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for each elevator. The certificate shall be provided to the Contracting Officer within 30 days after completion of all testing.

3.5.1 Testing Period

Each elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.

3.5.2 Speed Load Testing

The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 5 percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not exceed 10 percent of the total difference between the UP and DOWN speeds.

3.5.3 Car Leveling Testing

Elevator cars leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.

3.5.4 Brake Testing

Brake test shall be conducted with the rated-load in the car. Brakes shall stop and hold the car with the rated-load. In elevators using a Ward-Leonard type generator drive system it is critical to test the suicide circuit to assure that loop currents cannot cause the hoist motor to pull through the brakes.

3.5.5 Temperature Rise Testing

Temperature rise of hoistway motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions the temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Temperature rise testing shall be started when all parts of equipment are within the temperature required by NEMA at the time of starting the tests.

3.5.6 Insulation-Resistance Testing

Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not

less than one megohm between each conductor and ground, and not less than one megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.

3.6 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under glass or in laminated plastic, and posted side-by-side in the elevator room where directed, before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instruction shall include the condensed operating instructions explaining preventive maintenance procedures, the methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.

3.7 OPERATOR TRAINING

Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of the elevator equipment. Training period of the elevator equipment. Training period shall consist of a total of 32 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of starting the training course.

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SECTION 15070A

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SECTION 15070A

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA Seismic Restraint Mnl (1998) Seismic Restraint Manual Guidelines
for Mechanical Systems

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Water Heaters	Storage Tanks for Oil and Water
Expansion Air Separator Tanks	Water and Gas Piping
Heat Exchangers	Valves and Fittings for Piping
Water Chiller Units	Air and Refrigerant Compressors
Refrigerant Piping	Air Handling Units
Pumps with Motors	Ducts
	Exhaust and Return Fans
	Fan Coil Units
	Reheat Coil

1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building Except as Specifically Stated Below
Under "Items Not Covered By This Section".
Chilled Water Distribution Systems Outside of Buildings
Fuel Piping Outside of Buildings
All Water Supply Systems
Storm and Sanitary Sewer Systems
Water Storage Tanks

1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, the AISC LRFD Specifications shall be used for the design.

1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in TI 809-04.

1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

- a. Gas piping less than 25 mm inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than 32 mm inside diameter.
- c. All other piping less than 64 mm inside diameter.
- d. Rectangular air handling ducts less than 0.56 square meters in cross sectional area.
- e. Round air handling ducts less than 711 mm in diameter.
- f. Piping suspended by individual hangers 300 mm or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- g. Ducts suspended by hangers 300 mm or less in length from the top of the duct to the bottom of the supporting structural member,

except as noted below.

In exemptions f. and g. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

1.3 EQUIPMENT REQUIREMENTS

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

- Chillers
- Air-Handling Units
- Cooling Towers
- Water Storage Tanks
- Water Heaters

1.3.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 2 times the operating weight of the equipment at the vertical center of gravity of the equipment.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Coupling and Bracing.
- Flexible Couplings or Joints.
- Equipment Requirements.
- Contractor Designed Bracing; G.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation

with relation to the building construction.

SD-03 Product Data

Coupling and Bracing; G.
Equipment Requirements; G.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G.

Copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

SD-07 Certificates

Flexible Ball Joints.

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

PART 2 PRODUCTS

2.1 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

2.2 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement.

2.3 FLEXIBLE MECHANICAL JOINTS

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe

sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

2.4 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the Contracting Officer before installation.

2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 1.5 m line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 meters per meter of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 90 mm in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside

of building to satisfy these requirements.

3.3.2 Underground Piping

Underground piping and 100 mm or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 76 mm of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07840a FIRESTOPPING.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 100 mm (4 inches) apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 12 m intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be

used as sway braces.

3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 3 m (10 foot) vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway branches shall not be connected to branch lines, walls, or floors.

3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.7 SWAY BRACES FOR DUCTS

3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA Seismic Restraint Mnl, including Appendix E. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in TI 809-04.

3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 50 mm of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 150 mm minimum clearance to vertical ceiling hanger wires.

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SECTION 15080A

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209M	(2001) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2000e1) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995; R 2001) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(2000) Mineral Fiber Pipe Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(2000) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 612	(2000a) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992; R 1998e1) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 1996e1) Adhesives for Duct Thermal Insulation
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 882	(1997) Tensile Properties of Thin Plastic Sheeting
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards
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1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Insulation of heat distribution systems and chilled water systems outside of buildings shall be as specified in Section 02555a PREFABRICATED UNDERGROUND HEATING/COOLING DISTRIBUTION SYSTEM. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Mica Plates.

After approval of materials and prior to applying insulation, a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA Insulation Stds plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment that must be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation

application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label that identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

SD-03 Product Data

General Materials.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

SD-04 Samples

Thermal Insulation Materials.

After approval of materials actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the

job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A temporary covering shall be used to enclose and protect display sections for duct insulation exposed to weather.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 100 degrees C. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.4060 mm aluminum 25 x 25 mm with factory applied kraft backing. Aluminum shall be ASTM B 209M, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 100 mm wide rolls.

2.1.7 Staples

Outward clinching type monel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 6.1 N/mm width. ASTM C 921, Type II, minimum puncture

resistance 25 Beach units, tensile strength minimum 3.5 N/mm width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.4060 mm nominal thickness; ASTM B 209M, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.3960 mm thick, 12.7 mm wide for pipe under 300 mm diameter and 19.1 mm (3/4 inch) wide for pipe over 300 mm and larger diameter. Aluminum jacket circumferential seam bands shall be 50.8 x 0.4060 mm aluminum matching jacket material. Bands for insulation below ground shall be 19.1 x 0.5080 mm thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.7620 mm.

2.1.9 Vapor Retarder Required

2.1.9.1 Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.2 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 5.3 kN/m when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.1.9.4 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph 2.1.9.2 above.

2.1.10 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.1.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 34 degrees to plus 16 degrees C for outdoor, indoor, exposed or concealed applications, shall be as follows:

- a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.
- b. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

2.2.2 Aboveground Hot Pipeline

Insulation for above 16 degrees C, for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the

insulation with manufacturer's recommended factory-applied jacket.

- a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.
- b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 121 degrees C pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket.
- c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.
- d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 93 degrees C service.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, & IV.

2.3.2 Flexible Mineral Fiber

ASTM C 553: Type I, or Type II up to 121 C . ASTM C 1290 Type III.

2.3.3 Cellular Glass

ASTM C 552, Type I.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.4.1 Cold Equipment Insulation

For equipment operating temperatures below 16 degrees C.

2.4.1.1 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

2.4.2 Hot Equipment Insulation

For equipment operating temperatures above 16 degrees C.

2.4.2.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, IV, or V as required for temperatures encountered to 982 degrees C.

2.4.2.2 Flexible Mineral Fiber

ASTM C 553: Type I, II, III, IV, V, VI or VII as required for temperatures encountered to 649 degrees C.

2.4.2.3 Calcium Silicate

ASTM C 533, Type I, in-doors only, or outdoors above 121 degrees C. Pipe shape may be used on diesel engine exhaust piping and mufflers to 649 degrees C.

2.4.2.4 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 93 degrees C.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Fire-stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840a FIRESTOPPING.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTS AND COATINGS.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 93 degrees C. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

- c. Sanitary drain lines.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where pipes penetrate interior walls, the aluminum jacket shall extend 50 mm beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 250 mm above the floor with one band at the floor and one not more than 25 mm from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 50 mm above the flashing with a band 25 mm from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 50 mm beyond the interior surface of the wall.
- g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 50 mm down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.
- h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 50.0 mm and shall seal the end of the insulation. Glass tape seams shall overlap 25 mm . The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 10 mm .
- i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration).

The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm . The coating shall extend out onto the insulation 50 mm and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 10 mm .

3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 50 mm and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 50 mm shall be installed.
- b. Horizontal pipes larger than 50 mm at 16 degrees C and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400A PLUMBING, GENERAL PURPOSE.
- c. Horizontal pipes larger than 50 mm and below 16 degrees C shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 27 C), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm , wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.
- d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm , wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous

over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 9 m , the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

- e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 38 mm, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 150 mm and less. Type II sheet insulation used on pipes larger than 150 mm shall not be stretched around the pipe. On pipes larger than 300 mm, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, and mechanical rooms aluminum jackets shall be utilized. Pipe insulation to the 1.8 m level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 34 degrees C to plus 16 degrees C:

- a. Refrigerant suction lines.
- b. Chilled water.
- c. Air conditioner condensate drains.
- d. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (mm)

Type of Service	Material	Run-outs up to 50 mm*	25 mm & less	30 & 50 mm	65 - 100 mm	125 - 150 mm	205 mm & larger
Refrigerant suction piping	CG		40	40	40	40	40
	FC		25	25	25	25	25
Chilled water supply & return piping	CG	40	40	40	50	50	50
Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap personnel	FC	15	15	15	15	20	20
	MF	15	25	25	40	40	40
Air conditioning condensate drain located inside building	FC		10	15	15	N/A	N/A

*When run-outs to terminal units exceed 3.66 m the entire length of run-out shall be insulated like the main feed pipe. Insulations may not be applied if their flame and smoke developed ratings exceed the requirements of 25/50 established in this guide specification. Layered insulations, or installation where multiple layers of the same insulation are used, must be checked for this (in particular if the insulation has been rated per ASTM E 84 for one thickness).

LEGEND:

- CG - Cellular Glass
- MF - Mineral Fiber
- FC - Flexible Elastomeric Cellular

3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building, to be protected with an aluminum jacket, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such

as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 1.8 m level shall be protected.

3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

- a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.
- b. Longitudinal laps of the jacket material shall overlap not less than 38 mm. Butt strips 75 mm wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm centers if not factory self-sealing. If staples are used, they shall be sealed per item "e." below. Note that staples are not required with cellular glass systems.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 50 degrees C during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape.
- f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape. The patch shall extend not less than 38 mm past the break.
- g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape.

3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as

modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 2.0 mm, applied with glass tape embedded between coats. Tape seams shall overlap 25 mm. The coating shall extend out onto the adjoining pipe insulation 50 mm. Fabricated insulation with a factory vapor retarder jacket shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 2 mm and with a 50 mm wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 100 mm wide ASJ tape which matches the jacket of the pipe insulation.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 150 mm from the insulation surface.
- e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 16 degrees C shall be insulated per Table II:

- a. Domestic hot water supply & re-circulating system.

b. Central Plant heat pump hot water supply and return.

3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

LEGEND:

CG - Cellular Glass
 CS - Calcium Silicate
 MF - Mineral Fiber
 FC - Flexible Elastomeric Cellular

Table II - Hot Piping Insulation Thickness
 Pipe Size (mm)

Type of Service (degrees C)	Material	Run-outs up to 50 mm*	25 mm & less	32 - 50 mm	65 - 100 mm	125 - 150 mm	205 mm & larger
Hot domestic water supply & re-circulating system & Water defrost lines (93C max)**	CG	40	40	40	40	40	40
	MF	15	40	40	40	40	40
Hot domestic water supply & recirculating system Central Plant heat pump hot water supply and return (93.3 C max)	CG	38	38	38	38	38	38
	MF	13	25	25	38	38	38

* When run-outs to terminal units exceed 3.66 m, the entire length of run-out shall be insulated like the main feed pipe.

** Applied to re-circulating sections of service or domestic hot water systems and first 2.4 meters from storage tank for non-re-circulating systems.

3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied

aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 38 mm, and butt strips 75 mm wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 49 degrees C and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is non-adhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 100 mm centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 38 mm past the break.
- f. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slitted sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 150 mm shall not be stretched around the pipe. On pipes larger than 300 mm, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.3.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12, and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for

couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory jackets or PVC fitting covers shall be protected with two coats of adhesive applied with glass tape embedded between coats. Tape seams shall overlap 25 mm. Adhesive shall extend onto the adjoining insulation not less than 50 mm. The total dry film thickness shall be not less than 2.0 mm.
- d. Insulation terminations shall be tapered to unions at a 45-degree angle.
- e. At the option of the Contractor, factory pre-molded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory pre-molded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 50 mm at longitudinal and circumferential joints and shall be secured with bands at not more than 300 mm centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 16 degrees C and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 16 degrees C and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 16 degrees C shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 25 mm and the adjoining aluminum jacket not less than 50 mm. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.4.4 Below Ground Pipe Insulation

Below ground pipe insulation for underground chilled water and hot water systems shall be applied as specified in Section 02555a PREFABRICATED UNDERGROUND HEATING/COOLING DISTRIBUTION SYSTEM.

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket.

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III.

Table III - Minimum Duct Insulation (mm)

Cold Air Ducts	50
Fresh Air Intake Ducts	40

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air

ducts and associated equipment.

- a. Supply ducts.
- b. Return air ducts.
- c. Flexible run-outs (field-insulated).
- d. Plenums.
- e. Duct-mounted coil casings.
- f. Coil headers and return bends.
- g. Coil casings.
- h. Fresh air intake ducts.
- i. Filter boxes.
- j. Mixing boxes (field-insulated).

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 12 kg per cubic meter and rigid type where exposed, minimum density 48 kg per cubic meter. Insulation for round/oval ducts shall be flexible type, minimum density 12 kg per cubic meter with a factory Type I or II jacket; or, a semi rigid board, minimum density 48 kg per cubic meter, , formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 2.0 mm.. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 150 mm wide strips on 300 mm centers.
- b. For rectangular and oval ducts, 600 mm and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 400 mm

centers and not more than 400 mm from duct corners.

- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 400 mm centers and not more than 400 mm from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 50 mm. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 50 mm beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 50 mm. Pin puncture coatings shall extend 50 mm from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 300 mm apart and not more than 75 mm from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 300 mm and larger. One row shall be provided for each side of duct less than 300 mm.

- b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.
- d. Joints in the insulation jacket shall be sealed with a 100 mm wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.
- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 50 mm beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 50 mm. Pin puncture coatings shall extend 50 mm from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 12 kg per cubic meter, attached as per MICA standards.

3.3.3 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted

on the following:

- a. Hand-holes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.

3.4.2 Insulation for Cold Equipment

Cold equipment below 16 degrees C: Insulation shall be furnished on equipment handling media below 16 degrees C including the following:

- a. Pumps.
- b. Refrigeration equipment parts that are not factory insulated.
- c. Drip pans under chilled equipment.
- d. Duct mounted coils.
- e. Chilled water pumps.
- f. Air handling equipment parts that are not factory insulated.
- g. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

- a. Equipment handling media between 2 and 16 degrees C: 40 mm thick cellular glass, 25 mm thick flexible elastomeric cellular, 40 mm thick phenolic foam, or 25 mm thick polyisocyanurate foam.
- b. Equipment handling media between minus 18 degrees C and plus 1 degrees C: 75 mm thick cellular glass, 40 mm flexible elastomeric cellular, 40 mm thick phenolic foam, or 40 mm thick polyisocyanurate foam.
- c. Equipment handling media between minus 34 degrees C and minus 18 degrees C: 90mm thick cellular glass 45 mm thick flexible elastomeric cellular, 40 mm thick phenolic foam, or 40 mm thick polyisocyanurate foam.

3.4.2.2 Pump Insulation

- a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints

that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

- b. Exposed insulation corners shall be protected with corner angles.
- c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 300 mm centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. Phenolic foam insulation shall be set in a coating of bedding compound and joints shall be sealed with bedding compound as recommended by the manufacturer. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.
- d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm.
- e. Exposed insulation corners shall be protected with corner angles.
- f. Insulation on equipment with ribs shall be applied over 150 x 150 mm by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the

fabric with J-hooks and 50 x 50 mm washers or shall be securely banded or wired in place on 300 mm centers.

3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 2.0 mm. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 16 degrees C including the following:

- a. Heat exchangers.
- b. Pumps handling media above 54 degrees C.
- c. Hot water storage tanks.
- d. Air separation tanks.
- e. Unjacketed boilers or parts of boilers.
- f. Boiler flue gas connection from boiler to stack (if inside).

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

Legend

- RMF: Rigid Mineral Fiber
- FMF: Flexible Mineral Fiber
- CS: Calcium Silicate
- CG: Cellular Glass
- FC: Flexible Elastomeric Cellular

TABLE IV
Insulation Thickness for Hot Equipment (mm)

Equipment handling steam or other media to indicated pressure or temperature limit	Material	Thickness
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103.4 kPa	RMF	50 mm
or	FMF	50 mm
121 C	CS	100 mm
	CG	75 mm
	FC(<93 C)	25 mm
<hr/>		
1379.0kPa	RMF	75 mm
or	FMF	75 mm
204 C	CS	100 mm
	CG	100 mm
<hr/>		
316 C	RMF	125 mm
	FMF	150 mm
	CS	150 mm
	CG	150 mm

316 C: Thickness necessary to limit the external temperature of the insulation to 50 C, except that diesel engine exhaust piping and mufflers shall be covered with 150 mm thick material suitable for 650 degrees C service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 2.0 mm. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 300 mm centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. On high vibration equipment, cellular glass insulation shall be

set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

- d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.
- e. Exposed insulation corners shall be protected with corner angles.
- f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 150 x 150 mm by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 50 x 50 mm washers or shall be securely banded or wired in place on 300 mm (maximum) centers.
- g. On equipment handling media above 316 degrees C, insulation shall be applied in two or more layers with joints staggered.
- h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 1112 N walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

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SECTION 15190A

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SECTION 15190A

GAS PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA Manual (1994; Addenda/Correction Jan 1996) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.45 (1995) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances

ANSI Z21.69 (1999) Connectors for Movable Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994; Supple 1 Jun 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.11 (1996) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.33 (1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2

ASME B16.5 (1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24

ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME B31.2	(1968) Fuel Gas Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(1994) Commercial Blast Cleaning
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UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1999) Gas and Oil Equipment Directory
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1.2 GENERAL REQUIREMENTS

1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures

and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05120 STRUCTURAL STEEL.

1.2.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System.

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

SD-03 Product Data

Qualifications.

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-06 Test Reports

Testing.

Pressure Tests.

Pressure Tests for Liquified Petroleum Gas.

Test With Gas.

Test reports in booklet form tabulating test and measurements performed. The reports shall be dated after award of this

contract, shall state the contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel butt welding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL Gas&Oil Dir, Class 20 or less. Tetrafluoroethylene tape shall conform to UL Gas&Oil Dir.

2.1.3 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.4 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 316 degrees C (600 degrees F) service. NBR binder shall be used for hydrocarbon service.

2.1.5 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.6 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

2.1.7 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transitions fittings.

2.1.8 Insulating Pipe Joints

2.1.8.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.8.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.8.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.1.9 Flexible Connectors

Flexible connectors for connecting gas utilization equipment to building gas piping shall conform to ANSI Z21.45. Flexible connectors for movable food service equipment shall conform to ANSI Z21.69.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves 50 mm and Smaller

Valves 50 mm and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.2.2 Valves 65 mm and Larger

Valves 65 mm and larger shall be carbon steel conforming to API Spec 6D, Class 150.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the service regulator to the connections to each gas utilization device.

3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.3 PROTECTIVE COVERING

3.3.1 Aboveground Metallic Piping Systems

3.3.1.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing or commercial sand blasted conforming to SSPC SP 6 and primed with ferrous metal primer. Primed surface shall be finished with two coats of exterior oil paint.

3.3.1.2 Nonferrous Surfaces

Except for aluminum alloy pipe, nonferrous surfaces shall not be painted. Surfaces of aluminum alloy pipe and fittings shall be painted to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. The surfaces shall be solvent-cleaned and treated with vinyl type wash coat. A first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel shall be applied.

3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA Manual, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 150 mm and larger, an approved gas cutting and beveling machine may be used. Cutting of thermoplastic and fiberglass pipe shall be in accordance with AGA Manual.

3.4.1 Metallic Piping Installation

Underground piping shall be buried a minimum of 450 mm below grade. Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction

will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Aluminum alloy pipe shall not be used in exterior locations or underground.

3.4.2 Metallic Tubing Installation

Metallic tubing shall be installed using gas tubing fittings approved by the tubing manufacturer. Branch connections shall be made with tees. All tubing end preparation shall be made with tools designed for the purpose. Aluminum alloy tubing shall not be used in exterior locations or underground.

3.4.3 Thermoplastic Piping, Tubing, and Fittings

Thermoplastic piping, tubing, and fittings shall be installed outside and underground only. Piping shall be buried a minimum of 450 mm below grade. The piping shall be installed to avoid excessive stresses due to thermal contraction. Thermoplastic piping shall only be installed underground by The Gas Company.

3.4.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.4.5 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.4.5.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

3.4.6 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 150 mm from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.4.7 Final Gas Connections

Unless otherwise specified, final connections shall be made with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to gas utilization equipment. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide

accessible gas shutoff valve and coupling for each gas equipment item.

3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 40 mm in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 50 mm in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.5.3 Joining Thermoplastic to Metallic Piping or Tubing

When compression type mechanical joints are used, the gasket material in the fittings shall be compatible with the plastic piping and with the gas in the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Sleeves in mechanical room floors above grade shall extend at least 100 mm above finish floor. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 6.4 mm all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or

ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, the annular space between the pipe and sleeve shall be sealed with firestopping material and sealant that meet the requirement of Section 07840a FIRESTOPPING.

3.7 PIPES PENETRATING WATERPROOFING MEMBRANES

Pipes penetrating waterproofing membranes shall be installed as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.8 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section 07840a FIRESTOPPING.

3.9 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

3.11 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

3.12 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 3.2 mm shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

The gas piping system within the building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70. Conventional

flange joints allow sufficient current flow to satisfy this requirement.

3.14 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.15 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.15.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 21 kPa gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 1 kPa. The source of pressure shall be isolated before the pressure tests are made.

3.15.2 Pressure Tests for Liquified Petroleum Gas

Systems shall withstand the pressure test described above. When appliances are connected to the piping system, fuel gas shall be used for testing and appliances shall withstand a pressure of not less than 2.5 kPa nor more than 3.5 kPa for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device calibrated to be read in increments of not greater than 20 Pa. The source of pressure shall be isolated before the pressure tests are made.

3.15.3 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

3.15.4 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.15.5 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

-- End of Section --

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SECTION 15400A

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

- ARI 1010 (1994) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers
- ARI 700 (1999) Specifications for Fluorocarbon and Other Refrigerants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z21.10.1 (1998; Z21.10.1a; Z21.10.1b; Z21.10.1c) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
- ANSI Z21.10.3 (1998) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters
- ANSI Z21.22 (1999) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 105/A 105M (2001) Carbon Steel Forgings for Piping Applications
- ASTM A 193/A 193M (2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- ASTM A 515/A 515M (2001) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
- ASTM A 516/A 516M (2001) Pressure Vessel Plates, Carbon

	Steel, for Moderate- and Lower-Temperature Service
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 888	(1998e1) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(2000) Solder Metal
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 641	(1995) Seamless and Welded Copper Distribution Tube (Type D)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(2000) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(1999e1) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 2822	(1991; R 1997e1) Asphalt Roof Cement
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E 1	(2001) ASTM Thermometers
ASTM F 409	(1999a) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING

ENGINEERS (ASHRAE)

- ASHRAE 34 (2001; Errata 2002) Number Designation and Safety Classification of Refrigerants
- ASHRAE 90.1 (2001; Errata 2002) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- ASSE 1001 (2002) Pipe Applied Atmospheric Type Vacuum Breakers
- ASSE 1002 (1999) Anti-siphon Fill Valves (Ballcocks) for Water Closet Flush Tanks
- ASSE 1003 (2001) Water Pressure Reducing Valves
- ASSE 1005 (1999) Water Heater Drain Valves
- ASSE 1011 (1993) Hose Connection Vacuum Breakers
- ASSE 1012 (1993) Backflow Preventers with Intermediate Atmospheric Vent
- ASSE 1013 (1999) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
- ASSE 1018 (2001) Trap Seal Primer Valves, Water Supply Fed
- ASSE 1020 (1998) Pressure Vacuum Breaker Assembly
- ASSE 1037 (1990; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION(AWWA)

- AWWA B300 (1999) Hypochlorites
- AWWA B301 (1999) Liquid Chlorine
- AWWA C105 (1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
- AWWA C203 (1997; C203a99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
- AWWA C606 (1997) Grooved and Shouldered Joints

AWWA D100 (1996) Welded Steel Tanks for Water Storage

AWWA EWW (1998) Standard Methods for the Examination of Water and Wastewater

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

AWS B2.2 (1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2 (1991; R 1998) Air Gaps in Plumbing Systems

ASME A112.14.1 (1975; R 1998) Backwater Valves

ASME A112.18.1M (2000) Plumbing Fixture Fittings

ASME A112.19.1M (1994; R 1999) Enameled Cast Iron Plumbing Fixtures

ASME A112.19.2M (1998) Vitreous China Plumbing Fixtures

ASME A112.19.3M (2001) Stainless Steel Fixtures (Designed for Residential Use)

ASME A112.19.4M (1994; R 1999) Porcelain Enameled Formed Steel Plumbing Fixtures

ASME A112.21.1M (1991; R 1998) Floor Drains

ASME A112.36.2M (1991; R 1998) Cleanouts

ASME A112.6.1M (1997) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME B1.20.1 (1983; R 2001) Pipe Threads, General Purpose (Inch)

ASME B16.12 (1998) Cast Iron Threaded Drainage Fittings

ASME B16.15 (1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250

ASME B16.18 (2001) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.34 (1996) Valves Flanged, Threaded, and Welding End

ASME B16.39 (1998) Malleable Iron Threaded Pipe Unions

ASME B16.4 (1998) Gray Iron Threaded Fittings

ASME B16.5 (1996) Pipe Flanges and Flanged Fittings

ASME B31.1 (2001) Power Piping

ASME B31.5 (2001) Refrigeration Piping and Heat Transfer Components

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPVC SEC VIII D1 (2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPVC SEC IX (2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME CSD-1 (2002) Control and Safety Devices for Automatically Fired Boilers

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (2000) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI 310 (1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI HSN-85 (1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube A 4015 (1994; R 1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-CCC (9th Edition) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5 (1994) Centrifugal Nomenclature

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.1 (1995) Plastic Bathtub Units

IAPMO Z124.5 (1997) Plastic Toilet (Water Closets) Seats

INTERNATIONAL CODE COUNCIL (ICC)

CABO A117.1 (1998) Accessible and Usable Buildings and Facilities

ICC International Plumbing Code (2000) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (2002) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73 (1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78 (1998) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (2001) Installation of Oil Burning Equipment

NFPA 54 (1999) National Fuel Gas Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14 (2002) Plastics Piping Components and Related Materials

NSF 61 (1999;2001 Addendum 1 - Sep 2001) Drinking Water System Components - Health Effects

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101 (1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J 1508 (1997) Hose Clamp Specifications

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-240 (Rev A; Canc. Notice 1) Shower Head, Ball Joint

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer Products

PL 93-523

(1974; Amended 1986) Safe Drinking Water
Act

UNDERWRITERS LABORATORIES (UL)

UL 174

(1996; Rev thru Oct 1999) Household
Electric Storage Tank Water Heaters

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics.

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-03 Product Data

Welding.

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule.

Catalog cuts of specified plumbing fixtures, valves system and system location where installed.

Vibration-Absorbing Features.

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System.

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment.

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts.

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05120 STRUCTURAL STEEL.

1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with ICC International Plumbing Code.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II.

Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8.

End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- d. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- e. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

- f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.
- g. Solder Material: Solder metal shall conform to ASTM B 32.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- k. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J 1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.

- j. Liquid Chlorine: AWWA B301.
- k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.
- l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- m. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and	MSS SP-85

Description	Standard
Threaded Ends	
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Hose Bibs

Hose bibs with vacuum-breaker backflow preventer shall be brass with 20 mm (3/4 inch) male inlet threads, hexagon shoulder, and 20 mm (3/4 inch) hose connection. Hose bib handle shall be securely attached to stem. Where indicated on drawings, provide hose bibbs integral with recessed wall hydrant boxes with bronze box construction, chrome plated finish, integral vacuum beaker, hinged locking cover and tee handle key.

2.3.2 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 20 mm (3/4 inch) pipe. Body shall be suitable for wrench grip. Faucet spout shall have 20 mm (3/4 inch) exposed hose threads. Faucet handle shall be securely attached to stem.

2.3.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) shall have 20 mm (3/4 inch) minimum inlets, and 20 mm (3/4 inch) outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) shall have 25 mm (1 inch) minimum inlets, and 25 mm (1 inch) outlets. The discharge pipe from the relief valve shall be the size

of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting. The mixing valve shall be suitable for use with hot return systems. Factory assembled high-low manifold mixing systems shall be provided as indicated on the contract drawings. Pressured drop thru mixing valves and manifold mixing systems shall be limited to 34.5 Kpa (5 psig).

2.3.5 Pressure Reducing Valves

Automatic, hydraulically controlled, pressure reducing valve capable of automatically reducing a higher inlet water pressure to a constant lower outlet water pressure regardless of changing flow rates and/or varying inlet water pressure. The pressure reducing valve assembly size, capacity, flow characteristics, pressure drop, and pressure setting as indicated on drawings. The valve assembly shall be equipped with gauges, reducers, unions, by-pass valve, isolation valves, Y-strainers, position indicators, flo-clean strainers, limit switches, and adjustable closing feature.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC International Plumbing Code. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in

contact with hot water shall be suitable for 82 degrees C (180 degrees F) water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled, oval, countertop type for use in barracks buildings.

2.4.2 Automatic Flushing System

Flushing system shall consist of solenoid-activated flush valve with electrical-operated light beam sensor to energize solenoid. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS. Provide 24V/115V transformers as required.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-CCC. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2. Provide indirect drain lines to floor sinks as required.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 300 mm (12 inch) nominal overall width or diameter and 250 mm (10 inch) nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.21.1M.

2.6.3 Floor Sinks

Floor sinks shall be square, with 300 mm (12 inch) nominal overall width or diameter and 250 mm (10 inch) nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm (0.032 inch) thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm (2 inches). The interior diameter shall be not more than 3.2 mm (1/8 inch) over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with

cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 GREASE INTERCEPTOR

Grease interceptor of the size indicated shall be of reinforced concrete, with removable three-section, 9.5 mm (3/8 inch) checker-plate cover, and shall be installed outside the building. Steel grease interceptor shall be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Interceptors shall be tested and rated in accordance with PDI G 101. Concrete shall have 21 MPa minimum compressive strength at 28 days.

2.9 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C (90 to 160 degrees F). Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C (120 to 180 degrees F). Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 93 degrees C water temperature and 1034 kPa working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.9.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.9.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 22 KW (75,000 BTU per hour) or less or ANSI Z21.10.3 for heaters with input greater than 22 KW (75,000 BTU per hour). Water heater shall be furnished with electronic ignition. See equipment scheduled on contact drawings.

2.9.1.2 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time. See equipment schedule on

contract drawings.

2.10 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm (7 inch) scale.

Thermometer shall have a separable socket suitable for a 20 mm (3/4 inch) tapped opening. Tanks shall be equipped with a pressure gauge 155 mm (6 inch) minimum diameter face. Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.11 EXPANSION TANKS

Expansion tanks shall be welded steel, constructed, tested and stamped in accordance with ASME BPVC VIII Div 1 for a working pressure of 862 kPa (125 psig) and precharged to the minimum operating pressure. Expansion tanks shall have a replaceable bladder and be the captive air type. Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with an air charging valve. Tanks shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing

check valve, and a stop valve in an accessible location near the pump.

2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be integrally mounted on a cast-iron or steel subbase, or supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage (horsepower) for the service required. Pump shall conform to HI 1.1-1.5. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 746 W (Fractional horsepower pump motors) shall have integral thermal overload protection in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

2.12.3 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.13 PLATE HEAT EXCHANGER

a. Furnish and install as shown on the plans, a double wall Plate and Frame Heat Exchanger. The Plate and Frame Heat Exchanger manufacturer, shall have an extensive background in the design and fabrication of Plate and Frame Heat Exchangers. The manufacturer shall have a minimum of five (5) years experience in the fabrication of plate heat exchangers. Double Wall Heat Exchangers shall be designed, constructed, and tested in accordance with Section VIII, Division 1 of the ASME Pressure Vessel Code, and shall be code stamped.

b. Preference will be given to single pass designs with all connections on the fixed cover. The fixed and movable covers shall be of sufficient thickness, for the design pressure and code requirements and shall have no reinforcement or stiffeners. The moveable cover shall be provided with a steel roller bearing, for units greater than 1270 mm (50 inch) in height (from bottom of feet). This allows the movable cover to be moved without additional rigging or handling equipment. Carrying and guide bar, shall be designed to allow for expansion of at least 15%. The carrying and guide bar guiding system shall be precision manufactured of stainless steel, to prohibit corrosion and facilitate movement of the plates, painted or plated surfaces are not permitted. Entire frame shall be bolted together to allow unit to be field assembled, to permit rigging into place. Welding of frame components is not permitted. Plate and carrying bar designs, shall permit the removal and access to any plate in the plate pack, without the need to remove any other plates. Provide lifting

lugs, designed to allow lifting of the entire units flooded weight. All steel surface shall be thoroughly cleaned and prepared for painting per SSPC-SPIO63T, painting over mill scale is not acceptable. All steel components shall be epoxy coated.

c. Connections equal to or less than 50 mm (2 inch) shall be stainless steel NPT type. To avoid leakage on port area, studed port design shall be provided on heat exchangers with connections greater than 50 mm (2 inch). Flanged nozzle connections are not acceptable.

d. Compression bolts shall not require special tools and shall be equipped with lock washers at the movable cover, to facilitate opening and closing of the unit from the fixed cover only. Compression bolts shall be equipped with captive nuts at the fixed cover and threaded nuts at the movable cover. Welding of the nut to the closure bolt is prohibited. Bolts with rolled threads to reduce galling, and double width hex nuts, to adequately distribute the load, shall be provided. Ball bearing box washers shall be located at all critical closing bolts on units greater than 1270 mm (50 inch) in height. Bolts, shall be liberally coated with Lubriplate FGL-2 for lubrication and rust prevention, and covered with a plastic sleeving for protection from the environment and prevent bodily injury. Zinc plating is prohibited.

e. The double wall plate and frame heat exchangers shall consists of pressed type 304 stainless steel plates (or other alloys), to provide the required heat transfer area to meet the operating conditions specified. Individual plates shall be pressed from a homogeneous single metal sheet in one step. No multi-stage pressing of one sheet is allowed. Each heat transfer plate to be with herringbone corrugations, to optimize heat transfer, with nominal pressure losses. Corrugations to be designed to provide support to adjacent plates at evenly distributed support points. This allows pressurization of each circuit to a full differential of 1.5 times the design pressure, for one hour without buckling or deformation of the heat transfer plates. All plates and gaskets shall be permanently marked to identify quality and material. Each heat transfer plate shall have a built-in-self aligning system, to accurately locate the plates in the frame assembly, and prevent lateral plate movement, while maintaining maximum gasket contact under pressure. Plates shall be reinforced on the upper and lower mounting slots, to avoid bending of the hangers on the plates. The double wall plate and frame heat exchanger, shall be designed to perform to various capacities and pressure drops as shown on the schedule. Plates to be 304 stainless steel with II B finish and tapered gasket grooves. The plate pack shall be covered with an aluminum shroud in accordance with OSHA.

f. Gaskets shall have relieving grooves to prevent intermixing of fluids and cause leakage to flow to the outside of the unit. One piece molded gaskets shall be required. These gaskets shall fit around both the heat transfer area and port holes. Preference shall be given to non-glued gasketing systems. If an adhesive is necessary, it shall be compatible with the gasket material and the fluids. The adhesive shall be a 2 component, heat cured epoxy glue.

g. The double wall plate heat exchanger shall be designed to withstand full test pressure in one circuit with zero pressure in the alternate circuit. Hydrostatic testing shall be in accordance with ASME Section VIII, Division, 1 Paragraph UG-99.

2.14 LEAK DETECTION SYSTEM FOR WATER

The leak detection system shall consist of a monitoring panel, cable, and water sensors. Dorlen Products "Water Alert" sensing alarm with Model RI-2 Remote indicator or approved equal. The system shall consist of the following:

- a. The panel shall contain a power on-off switch, and audible alarm, an alarm silence switch, a test switch, and an indicator light for each water sensor (minimum of 6 each). The panel shall be table mounted with a 120 volt power connection.
- b. The water sensors shall be mounted (where indicated) on the concrete floor in the crawlspace and wired to the panel.
- c. The sensor cable size and type shall be as recommended by the system manufacturer for the proper operation of the system.

2.14.1 Operation

The leak detection panel shall monitor each individual sensor. When water is detected by a sensor, the corresponding visual indicator will light and the alarm will sound. The silencer switch shall silence the audible alarm but the visual indicator shall remain lit until the water is removed from the sensor. The test switch shall illuminate all the indicators and sound the alarm to ensure proper operation of the system.

2.14.2 Installation

The installation of the leak detection system shall be in accordance with the manufacturer's recommendation.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 150 mm above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm below the finish grade or as indicated

on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body. Buried piping near and under buildings shall be installed per granular termite barrier manufacturer's recommendations.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are

furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm (3/4 inch) hose bibb with renewable seat and gate or ball valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) and larger.

3.1.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube A 4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm (2 inches) and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube A 4015.

3.1.6 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.7 Corrosion Protection for Buried Pipe and Fittings

3.1.7.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be

cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.7.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.8 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.8.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4 inch) clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900a JOINT SEALING. The annular space between pipe and

sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm (1/2 inch) from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840a FIRESTOPPING.

3.1.8.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter (16 ounce) copper flashing, each within an integral skirt or flange.

Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm (10 inches) in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.8.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.8.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.8.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing. Penetrations shall be sealed as indicated on the drawings.

3.1.9 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840a FIRESTOPPING.

3.1.10 Supports

3.1.10.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.10.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

3.1.10.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 100 mm (4 inches).
 - (2) Be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or less.
 - (3) Have a high density insert for pipe 50 mm (2 inches) and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 128 kg per cubic meter (8 pcf) or greater.
- l. Type 35 guides using steel, reinforced polytetrafluoroethylene

(PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

- (1) On pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 100 mm (4 inches) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 100 mm (4 inches) and larger carrying medium less than 15 degrees C a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.

3.1.11 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.12 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm (4 inches) will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be

flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm (4 inches). Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 150 mm above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be

routed horizontally and downward a minimum of 600 mm before turning in an upward direction.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Bumpers for water closet seats shall be installed on the flushometer stop.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm above floor. Wall-hung service sinks shall be mounted with rim 700 mm above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.4 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC International Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around

backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500a MISCELLANEOUS METAL.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.5 IDENTIFICATION SYSTEMS

3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm (1-3/8 inch) minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTS AND COATINGS.

3.8 TESTS, FLUSHING AND DISINFECTION

3.8.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC International Plumbing Code.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of
Gauges	

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall

be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.8.3 System Flushing

3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 1.2 meters per second (4 fps) through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.8.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.

- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.8.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8.6 Flushing of Potable Water System

As an option to the system flushing specified above, the potable water system shall be flushed and conditioned until the residual level of lead is less than that specified by the base industrial hygienist. The water supply to the building shall be tested separately to ensure that any

lead contamination found during potable water system testing is due to work being performed inside the building.

3.9 PLUMBING FIXTURE SCHEDULE

3.9.1 Company Operations Facilities (COF 8 and 10)

P-1 WATER CLOSET

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters per flush. Flushometer shall be automatic flushing type. Flushometer shall be equipped with solenoid operator, light beam sensor and manual override button. Flushometer system shall be furnished with electrical boxes, mounting plates, and low-voltage transformers as required.

P-2 URINAL

Wall hanging, with integral trap and extended shields, ASME A112.19.2M washout. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 3.8 liters per flush. Flushometer shall be automatic flushing type.

P-3 LAVATORY

Manufacturer's standard sink depth, vitreous china, straight back. Nominal size 508 mm (20 inches) wide x 457 mm (18 inches) front to back. Furnish with concealed arm carriers.

Faucet - Faucets shall be single control, mixing type. Faucets shall have replaceable seats and washers. Faucets shall have metal or ceramic replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. The flow shall be limited to 0.16 liters per second at a flowing pressure of 549 kPa

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel.

P-4 Wash Sink

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M trap standard double compartments 1,295.4 mm wide x 698.5 mm deep (51 inches wide x 27-1/2 inches deep), splashback 228.6 mm (9 inches) high. Support on stainless steel legs.

Faucet and spout - cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, cross bars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm diameter.

P-5 Maintenance Sink

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M trap standard triple compartments 1,905.0 mm wide x 698.5 mm deep (75 inches wide x 27-1/2 inches deep), splashback 228.6 mm (9 inches) high. Support on stainless steel legs.

Faucet and spout - cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, cross bars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm diameter.

P-6 Service Sink, Floor Type

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.10.3M corner, floor mounted 711.2 mm (28 inches) square, 171.5 mm (6-3/4 inches) deep.

Faucet and spout - cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jamb nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-7 Shower

Shower heads, CID A-A-240 other than emergency showers shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) when tested in accordance with ASME A112.18.1M.

Wall Mounted: Shower head shall be nonadjustable spray, stainless steel or

chromium plated brass with ball joint. Handles shall be chrome-plated die cast zinc alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be thermostatic mixing type. Shower head shall be vandalproof with integral back. Mixing valve shall be memory positioning type which allows user to turn valve on and off at preferred temperature without re adjusting handle position each time.

P-8 WATER COOLER DRINKING FOUNTAINS:

Drinking fountains shall meet the requirements of NSF 61, Section 9. Water cooler drinking fountains shall: be self contained, conform to ARI 1010, use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05, have a capacity to deliver 30.2 liters per hour (8 gph) of water at 10 degrees C (50 degrees F) with an inlet water temperature of 27 degrees C (80 degrees F) while residing in a room environment of 32 degrees C (90 degrees F), and have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation with front and side easy touch control or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 100 mm (4 inches) high so as to allow the insertion of a cup or glass under the flow of water.

Surface Wall-Mounted - Surface wall-mounted units shall be 466 mm wide, 483 mm deep, and have a back height of 152.4 to 203.2 mm . The bowl shall be made of stainless steel. The unit shall have concealed fasteners and be for interior installation.

3.9.2 2.9.2 Barracks Buildings (BK-3 and BK-4)

P-1 WATER CLOSET

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - IAPMO ANSI/IAPMO Z124.5, Type A, white plastic, elongated, open front.

Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device.

Ballcocks shall meet ASSE 1002.

P-2 BATHTUB

Straight front, recessed, 1.524 m x 812.8 mm x 406.4 mm (60 x 32 x 16 in), enameled cast iron, ASME A112.19.1M raised bottom or porcelain enameled formed steel with structural composite reinforcement ASME A112.19.4M. Structural reinforcement shall be in accordance with IAPMO Z124.1 including appendix.

Drain Assembly - Plug, cup strainer, overflow assembly, washers, couplings, pop-up lever, trip lever, stopper, fittings, etc., shall be brass, cast copper alloy, or wrought copper alloy. See paragraph FIXTURES for optional plastic accessories.

P-3 LAVATORY

Manufacturer's standard sink depth, 483 (19 inches) wide x 381 mm (15 inches) front to back enameled cast iron ASME A112.19.1M self rimming type countertop, oval.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. The flow shall be limited to 0.16 liters per second at a flowing pressure of 549 kPa.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece.

P-4 KITCHEN SINK

Ledge back with holes for faucet and spout single bowl 609.6 x 533.4 mm (24 x 21 inches) 188 mm (7-1/2 inch deep) stainless steel ASME A112.19.3M.

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. The flow shall be limited to 0.16 liters per second at a flowing water pressure of 549 kPa.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-5 SERVICE SINK

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M trap standard 609.6 mm wide x 508.0 mm deep (24 inches wide x 20

inches deep), splashback 228.6 mm (9 inches) high.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm diameter.

P-6 SERVICE SINK

Single bowl, countertop 6096 x 508.0 mm (42 x 20 inches) stainless steel ASME A112.19.3M.

Faucet and Spout - Cast copper alloy, wrought copper alloy, cast iron, or stainless steel, with backflow preventer. Faucets shall have replaceable seat and the stem shall rotate onto the seat. Strainers shall have internal threads. Combination faucets shall be mounted on the tub back. Spouts shall be externally threaded for hose connection.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

Traps - Copper alloy, or cast iron.

P-7 Bath Showers

Bath showers shall include bathtub spout, shower head, valves, and diverters. A shower head mounting with ball joint shall be provided. Diverter shall be integral with single mixing valves or mounted hot and cold water valves. Tub spout shall be copper alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be pressure balanced type.

3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/0.093 sq. m. based on 27 degrees C delta T, or in percent per hour based on nominal 38 degrees C delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.11.1 Storage Water Heaters

3.11.1.1 Electric

- a. Storage capacity of 454 liters or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.
- b. Storage capacity of more than 454 liters or input rating more than 12 kW: maximum SL shall be 1.9 w/0.093 sq. m. per ASHRAE 90.1, Addenda B.

3.11.1.2 Gas

- a. Storage capacity of 379 liters or less, and input rating of 21980 W or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 379 liters - or input rating more than 21980 W: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.11.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter.

3.12 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X		X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10				X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
6	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B				X	X	

SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- E - Interior Rainwater Conductors Aboveground
- F - Corrosive Waste And Vent Above And Belowground
- * - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Seamless and welded copper distribution pipe, tube (typed) ASTM B 641	X**	X**	X**	X****
2	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
3	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 8 and 9	X	X	X	X
4	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
5	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
6	Malleable-iron threaded pipe unions ASME B16.39	X	X		
7	Nipples, pipe threaded ASTM A 733	X	X	X	

A - Cold Water Aboveground

B - Hot Water 82 degree C Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

** - Type L - Hard

*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING
EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	454 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	454 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/0.09 sq. m. maximum
Gas	380 max.		22 kW max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	380 min.	OR	22 kW min.	ANSI Z21.10.3	ET= 77 percent; SL = 1.3+38/V max.

B. Unfired Hot Water Storage, Instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter

TERMS:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0
(trace is permitted).

SL = Standby loss in W/0.09 sq. m. based on 27 degrees C delta T, or in
percent per hour based on nominal 32 degrees C delta T.

HL = Heat loss of tank surface area

V = Storage volume in gallons

-- End of Section --

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SECTION 15895A

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 350	(1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1998) Room Fan-Coils
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and

	Strip
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2001a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 88	(1999e1) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2000	(2001) Rubber Products in Automotive

Applications

ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 68	(1997) Laboratory Method of Testing to determine the Sound Power in a Duct
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
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ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2001) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(1998; 7th Edition Addenda 2000) EJMA Standards
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211 (2003) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

NFPA 54 (2002) National Fuel Gas Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds (1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible

SMACNA Install Fire Damp HVAC (1992; 2nd Printing 1996) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1419 (Rev D; Canc. Notice 1) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)

UNDERWRITERS LABORATORIES (UL)

UL 181 (1996; Rev thru Dec 1998) Factory-Made Air Ducts and Air Connectors

UL 1995 (1995; Rev thru Aug 1999) Heating and Cooling Equipment

UL 214 (1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films

UL 441 (1996; Rev thru Dec 1999) Gas Vents

UL 555 (1999; Rev thru Jan 2002) Fire Dampers

UL 586 (1996; Rev thru Apr 2000) High-Efficiency, Particulate, Air Filter Units

UL 900 (1994; Rev thru Oct 1999) Test Performance of Air Filter Units

UL 94 (1996; Rev thru May 2001) Tests for

Flammability of Plastic Materials for
Parts in Devices and Appliances

- UL Bld Mat Dir (1999) Building Materials Directory
- UL Elec Const Dir (2001) Electrical Construction Equipment Directory
- UL Fire Resist Dir (2001) Fire Resistance Directory (2 Vol.)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Drawings
- Installation

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-03 Product Data

- Components and Equipment

Manufacturer's catalog data shall be included with the detail

drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Piping Components
- b. Ductwork Components
- c. Air Systems Equipment
- d. Air Handling Units
- e. Energy Recovery Devices
- f. Terminal Units

Test Procedures

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; G

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Similar Services

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Joints

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Testing, Adjusting and Balancing

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-06 Test Reports

Performance Tests

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-07 Certificates

Bolts

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years

must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 PIPING COMPONENTS

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 25 mm (1 inch) and smaller shall be threaded; piping larger than 25 mm (1 inch) and smaller than 80 mm (3 inches) shall be either threaded, grooved, or welded; and piping 80 mm (3 inches) and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Welded Joints and Fittings

Welded fittings shall conform to ASTM A 234/A 234M, and shall be identified with the appropriate grade and marking symbol. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11.

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181/A 181M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to ASME B16.21, 2.0 mm thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193/A 193M.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Unions and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.5.3 Copper Tube

Copper tube shall conform to ASTM B 88, and ASTM B 88M, Type K or L.

2.5.4 Joints and Fittings For Copper Tube

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M . Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fittings and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves

located 3 meters or higher above the floor. Valves in sizes larger than 25 mm (1 inch) and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.5.1 Gate Valves

Gate valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, solder, or flanged ends.

Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70 and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.5.5.2 Globe Valves

Globe valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm (3 inches)

and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.3 Check Valves

Check valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 80 mm (3 inches) and larger shall conform to MSS SP-71 and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.5.4 Angle Valves

Angle valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 80 mm (3 inches) and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.5 Ball Valves

Ball valves 15 mm (1/2 inch) and larger shall conform to MSS SP-72 or MSS SP-110, and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.5.5.6 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 1.03 MPa. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.5.7 Balancing Valves

Balancing valves 50 mm (2 inches) or smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves 25 mm or larger may be all iron with threaded or flanged ends. The valves shall have a square head or similar device and an indicator arc and shall be designed for 120 degrees C. Iron valves shall be lubricated, nonlubricated, or tetrafluoroethylene resin-coated plug valves. In lieu of plug valves, ball valves may be used. Plug valves and ball valves 200 mm (8 inches) or larger shall be provided with manual gear operators with position indicators. Where indicated, automatic flow control valves may be provided to maintain constant flow, and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 862 kPa (125 psig) or 150 percent of the system operating pressure, whichever is the greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be appropriately increased. Where flow readings are provided by remote or portable meters, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter furnished with accessory kit as recommended by the automatic valve manufacturer shall be provided. Automatic flow control valve specified may be substituted for venturi tubes or orifice plate flow measuring devices.

2.5.5.8 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for pressure rating of piping system and furnished with threaded plugs or caps. Automatic air vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for pressure rating of piping system.

2.5.6 Strainers

Strainer shall be in accordance with ASTM F 1199, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 0.8 mm (22 gauge) corrosion-resistant steel, with small perforations numbering not less than 60 per square centimeter (400 per square inch) to provide a net free area through the basket of at least 3.3 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.5.7 Backflow Preventers

Backflow preventers shall be according to Section 15400A PLUMBING, GENERAL PURPOSE.

2.5.8 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 862 kPa (125 psi) or 1034 kPa (150 psi) service as appropriate for the static head plus the system head, and 120 degrees C, 110 degrees C for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.5.9 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm in diameter and shall have a range from 0 kPa to approximately 1.5 times the maximum system working pressure.

2.5.10 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 225 mm (9 inch) scale, and shall have rigid stems with straight, angular, or inclined pattern. Mercury shall not be used in thermometers.

2.5.11 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or setscrews.

2.5.12 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.5.13 Expansion Joints

2.5.13.1 Slip Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for working temperature and pressure suitable for the application, but not less than 1034 kPa (150 psig), and shall be according to applicable requirements of EJMA Stds and

ASME B31.1. End connections shall be flanged or beveled for welding as indicated. Joint shall be provided with an anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 0.058 mm of hard chrome according to ASTM B 650. All joint components shall be suitable for the intended service. Initial setting shall be made according to the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall be not more than 1.5 or smaller, guides shall be installed not more than 600 mm from the joint. Service outlets shall be provided where indicated.

2.5.13.2 Flexible Ball Joints

Flexible ball joints shall conform to EJMA Stds and ASME B31.1 and be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. The joint ends shall be threaded to 50 mm (2 inches) only, grooved, flanged, or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360 degree rotation. Balls and sockets shall be suitable for the intended service. The exterior spherical surface of carbon steel balls shall be plated with mils of hard chrome according to ASTM B 650. The ball type joints shall be designed and constructed according to EJMA Stds and ASME B31.1 where applicable. Where required, flanges shall conform to ASME B16.5.

2.5.13.3 Bellows Type Joints

Bellows type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows type expansion joints shall conform to the applicable requirements of EJMA Stds with internal sleeves. Guiding of piping on both sides of expansion joint shall be according to the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but not less than 1034 kPa (150 psig).

2.5.14 Insulation

Shop and field applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.5.15 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section 15400A PLUMBING, GENERAL PURPOSE.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to

Section 16415A ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 745 W and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 7.45 kW (10 hp) or less. Adjustable frequency drives shall be used for larger motors.

2.7 CONTROLS

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 125, 250, and 500 Pa (1/2, 1, and 2 inch w.g.) ductwork shall meet the requirements of Seal Class C. Class 750 through 2500 Pa (3 through 10 inch) shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 50 mm band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated.

2.8.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel, self supporting to 2.4 m spans. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 3.75 kPa (15 inches water gauge) at 177 degrees C (350 degrees F) when duct is aluminum, and 343 degrees C (650 degrees F) when duct is galvanized steel or stainless steel.

2.8.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 3 m. Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 150 mm in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.1.5 Gas Flue Vent Piping

The gas vent system for gas-fired water heaters shall be constructed to provide positive flow adequate to exhaust all flue gases to the outside atmosphere, without condensation within the vent or spillage at any water heater draft hood. All flue-gas carrying parts of the vent system shall be in accordance with UL 441, Type B double-wall gas vent piping, and such piping shall be continuous from the water heater outlet to the roof vent. Gas vent piping shall be constructed and installed in accordance with NFPA 54 and NFPA 211, and with the manufacturer's installation instructions.

2.8.2 Ductwork Accessories

2.8.2.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 375 x 450 mm, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 600 x 600 mm or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.8.2.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. A positive pressure relief door shall be provided upstream of fire dampers which are provided in the supply air and exhaust ducts. A negative pressure relief door shall be provided downstream of fire dampers which are provided in the return air ducts. The size and pressure relief rating of the relief doors shall be in accordance with the manufacturer's recommendations. The pressure relief door may be a combined pressure relief and access door unit if it is specifically listed by the manufacturer as such. A pressure relief door shall be provided upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed. Acceptance testing of fire dampers shall be performed per paragraph FIRE DAMPER ACCEPTANCE TEST and NFPA 90A.

2.8.2.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 5 mm (3/16 inch) rod brought through the side of the duct with locking setscrew and

bushing. Two rods are required on splitters over 200 mm (8 inches). Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 300 mm. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.8.2.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.8.3 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.8.3.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 375 mm in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 375 mm in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 1.0 mm (20

gauge) galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53/A 53M, Schedule 20 shall be used. Sleeve shall provide 25 mm clearance between the duct and the sleeve or 25 mm clearance between the insulation and the sleeve for insulated ducts.

2.8.3.2 Framed Prepared Openings

Openings shall have 25 mm clearance between the duct and the opening or 25 mm clearance between the insulation and the opening for insulated ducts.

2.8.3.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 100 mm wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 375 mm in diameter or less shall be fabricated from 1.0 mm (20 gauge) galvanized steel. Collars for round ducts larger than 375 mm and square, and rectangular ducts shall be fabricated from 1.3 mm (18 gauge) galvanized steel. Collars shall be installed with fasteners on maximum 150 mm centers, except that not less than 4 fasteners shall be used.

2.8.4 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 0.25 m/s (50 fpm) in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 2 m above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.8.4.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed

with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.8.4.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 150 mm below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 150 mm above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.8.5 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in Section 07600a SHEET METALWORK, GENERAL.

2.8.6 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel or aluminum sheets with galvanized or aluminum structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA HVAC Duct Const Stds. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.8.7 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, or stainless steel or extruded aluminum.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 140 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 11 kW (15 hp) and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of

the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan.

Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be backward-inclined or airfoil design in wheel sizes up to 750 mm (30 inches). Fan blades for wheels over 750 mm (30 inches) in diameter shall be backward-inclined or airfoil design. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motor starters shall be manual across-the-line type with general-purpose. Remote manual switch with pilot indicating light shall be provided where indicated.

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing.

Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Motors shall have open dripproof enclosure. Motor starters shall be manual across-the-line with general-purpose enclosures. Remote manual switch shall be provided where indicated.

2.9.1.3 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 600 mm (24 inches) diameter shall be direct or V-belt driven and fans with wheels 600 mm (24 inches) diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof type. Gravity backdraft dampers shall be provided where indicated.

2.9.1.4 Centrifugal Type Power Wall Ventilators

Fans shall be direct or V-belt driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an aluminum or plated steel wire discharge bird screen, anodized aluminum wall grille, manufacturer's standard gravity damper, an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be dripproof type. Lubricated bearings shall be provided.

2.9.1.5 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, gravity dampers, roof curb, and extended base. Motors enclosure shall be dripproof type. Lubricated bearings shall be provided.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and copper fins mechanically bonded or soldered to the tubes. Casing and tube support sheets shall be not lighter than 1.6 mm (16 gauge) galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 2.76 MPa (400 psi) air pressure and shall be suitable for 1.38 MPa (200 psi) working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.2.1 Direct-Expansion Coils

Direct-expansion coils shall be suitable for the refrigerant involved. Suction headers shall be seamless copper tubing or seamless or resistance welded steel tube with copper connections. Supply headers shall consist of a distributor which shall distribute the refrigerant through seamless copper tubing equally to all circuits in the coil. Tubes shall be circuited to ensure minimum pressure drop and maximum heat transfer. Circuited shall permit refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Each

coil to be field installed shall be completely dehydrated and sealed at the factory upon completion of pressure tests.

2.9.2.2 Water Coils

Water coils shall be installed with a pitch of not less than 10 mm per meter of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.9.3 Electric Reheat Coils

Electric reheat coils shall be low watt density, 304 stainless steel fin tubular construction, protected by thermal safety switches. Capacity and stages shall be as indicated.

2.9.4 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.4.1 Extended Surface Pleated Panel Filters

Filters shall be 50 mm (2 inch) depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.1. Initial resistance at 2.54 m/s (500 feet per minute) shall not exceed 9 mm water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.9.4.2 Holding Frames

Frames shall be fabricated from not lighter than 1.6 mm (16 gauge) sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.9.4.3 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 98 mm (3-7/8 inches) in diameter, shall have white dials with black figures, and shall be graduated in 0.0025 kPa mm (0.01 inch of water), and shall have a minimum range of 0.25 kPa (1 inch of water) beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure tips with integral compression fittings, two molded plastic vent valves,

two 1.5 m (5 foot) minimum lengths of 6.35 mm (1/4 inch) diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type as indicated. Units shall include fans, coils, airtight insulated casing, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.1.1 Casings

Casing sections shall be 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Inner casing of double-wall units shall be minimum 1.0 mm (20 gauge) solid galvanized steel. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 1.3 mm (18 gauge) outer and 1.0 mm (20 gauge) inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 300 mm wide by 300 mm high. Access doors shall be minimum 600 mm wide and shall be the full height of the unit casing or a minimum of 1800 mm, whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 25 mm (1 inch) thick, 24 kg per cubic meter (1-1/2 pound density) coated fibrous glass material having a thermal conductivity not greater than 0.033 W/m-K (0.23 Btu/hr-sf-F). Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casing sections. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges

and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071.

2.10.1.2 Cooling and Reheat Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.10.1.3 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.1.4 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit.

Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing.

Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 20 kW and below and fixed pitch above 20 kW as defined by ARI Guideline D.

Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have splashproof enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300 or ASHRAE 68.

2.10.1.5 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to

minimize air stratification and to promote thorough mixing of the air streams.

2.10.1.6 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.11 TERMINAL UNITS

2.11.1 Room Fan-Coil Units

Base units shall include galvanized coil casing, coil assembly drain pan valve and piping package, air filter, fans, motor, fan drive, and motor switch, plus an enclosure for cabinet models and casing for concealed models. Leveling devices integral with the unit shall be provided for vertical type units. Sound power levels shall be as indicated. Sound power level data or values for these units shall be obtained according to test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Each unit shall be fastened securely to the building structure. Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440, and shall meet the requirements of UL 1995.

2.11.1.1 Enclosures

Enclosures shall be fabricated of not lighter than 1.3 mm (18 gauge) steel, reinforced and braced. Front panels of enclosures shall be removable and provided with 13 mm (1/2 inch) thick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 23 m/s (4,500 fpm). Discharge grille shall be adjustable and shall be of such design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material shall comply with the heat deflection criteria specified in UL 1995. Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access doors or removable panels shall be provided for piping and control compartments. Duct discharge collar shall be provided for concealed models. Enclosures shall have easy access for filter replacement.

2.11.1.2 Fans

Fans shall be galvanized steel or aluminum, multiblade, centrifugal type. In lieu of metal, fans and scrolls may be non-metallic materials of suitably reinforced compounds. Fans shall be dynamically and statically balanced. Surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and re-assembly shall be by means of mechanical fastening devices and not by epoxies or cements.

2.11.1.3 Coils

Coils shall be constructed of not less than 10 mm (3/8 inch) outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Coils shall be provided with not less than 12 mm (1/2 inch) outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Coils shall be tested hydrostatically at 2000 kPa (300 psi) or under water at 1700 kPa (250 psi) air pressure and suitable for 1400 kPa (200 psi) working pressure. Provisions shall be made for coil removal.

2.11.1.4 Drain Pans

Drain and drip pans shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pans shall be constructed of not lighter than 0.9 mm (21 gauge) steel, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and shall be of a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans may be constructed of die-formed 0.85 mm (22 gauge) steel, formed from a single sheet, galvanized after fabrication, insulated and coated as specified for the 0.9 mm (21 gauge) material or of die-formed 0.9 mm (21 gauge) type 304 stainless steel, insulated as specified above. Drain pans shall be pitched to drain. Minimum 20 mm (3/4 inch) NPT or 15 mm (5/8 inch) OD drain connection shall be provided in drain pan. Auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages, may be plastic; if metal, the auxiliary pans shall comply with the requirements specified above. Insulation at control and piping connections thereto shall extend 25 mm minimum over the auxiliary drain pan.

2.11.1.5 Manually Operated Outside Air Dampers

Manually operated outside air dampers shall be provided according to the arrangement indicated. Dampers shall be parallel airfoil type and of galvanized construction. Blades shall rotate on stainless steel or nylon sleeve bearings.

2.11.1.6 Filters

Filters shall be of the fiberglass disposable type, 25 mm (1 inch) thick, conforming to CID A-A-1419. Filters in each unit shall be removable without the use of tools.

2.11.1.7 Motors

Motors shall be of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Motor switch shall be two or three speeds and off, manually operated, and shall be mounted on an identified plate adjacent to the room thermostat or as indicated. In

lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent may be provided. Motors shall have permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity shall not exceed the following values:

Free Discharge Motors

Unit Capacity (LS)	Maximum Power Consumption (Watts)		
	115V	230V	277V
94	70	110	90
142	100	110	110
189	170	150	150
283	180	210	220
378	240	240	230
472	310	250	270
566	440	400	440

High Static Motors

Unit Capacity (L/S)	Maximum Power Consumption (Watts)
94	145
142	145
189	210
283	320
378	320
472	530
566	530

2.12 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 3 mm. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 2 mm in 1 m. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 65 mm (2-1/2 inches) or less in diameter, and with flanges for pipe 80 mm (3 inches) and larger. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded.

3.1.1.1 Joints

- a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.
- b. Soldered Joints: Joints in copper tubing shall be cut square with ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with 95/5 solder or brazed with silver solder applied and drawn through the full fitting length. Care shall be taken to prevent annealing of tube or fittings when making connections. Joints 65 mm (2-1/2 inches) and larger shall be made with heat uniformly around the entire circumference of the joint with a multi-flame torch. Connections in floor slabs shall be brazed. Excess solder shall be wiped from joint before solder hardens. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.
- c. Welded Joints: Welding shall be according to qualified procedures

using qualified welders and welding operators. Procedures and welders shall be qualified according to ASME BPVC SEC IX. Welding procedures qualified by others and welders and welding operators qualified by another operator may be permitted by ASME B31.1. All welds shall be permanently identified by imprinting the welder's or welding operator's assigned symbol adjacent to the weld. Welded joints shall be fusion welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted.

Branch connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. Electrodes shall be stored and dried according to AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.1.2 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.2 Supports

3.1.2.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.2.2 Seismic Requirements (Pipe Supports and Structural Bracing)

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section.

3.1.2.3 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Types 5, 12, and 26 shall not be used.

- a. Hangers: Type 3 shall not be used on insulated piping.
- b. Inserts: Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.
- c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- f. Type 39 saddles shall be used on all insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is above 15.5 degrees C. Type 39 saddles shall be welded to the pipe.
- g. Type 40 shields shall:
 - (1) be used on all insulated pipes less than 100 mm (4 inches).
 - (2) be used on all insulated pipes 100 mm (4 inches) and larger when the temperature of the medium is 15.5 degrees C or less.
 - (3) have a high density insert for pipe 50 mm (2 inches) and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or when the insulation or jacket shows visible signs of distortion at or near the type 40 shield. High density inserts shall have a density of 144 kg/cubic meter (9 pcf) or greater.
- h. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 220 N (50 pounds) shall have the excess hanger loads suspended from panel points.
- i. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 5 m, not more than 2.4 m from end of risers, and at vent terminations.
- j. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be

provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

- k. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm (4 inches) and larger with medium 15.5 degrees C or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.
- l. High Temperature Guides with Cradles: Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm, or by an amount adequate for the insulation, whichever is greater.
- m. Insulated Pipe: Insulation on horizontal pipe shall be continuous through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 6 mm all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07900a JOINT SEALING. Pipes passing through wall waterproofing

membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed as indicated.

3.1.4.1 Roof and Floor Sleeves

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve or a 0.8 mm thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. Unless otherwise shown, the flashing sleeve shall extend up the pipe a minimum of 50 mm above highest floor level or a minimum of 250 mm above the roof. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm (10 inches) in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840a FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 50 mm plus 0.1 mm for each Pa, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided

where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm (4 inches) or smaller not more than 600 mm on each side of the joint.

3.1.7 Air Vents and Drains

3.1.7.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.9 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 150 mm (6 inch) concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and

foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.10 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500a MISCELLANEOUS METAL.

3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840a FIRESTOPPING for fire rated penetrations.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.14 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.15 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unit.

3.1.16 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.17 Power Roof Ventilator Mounting

Foamed 13 mm (1/2 inch) thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.18 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND COLOR CODE MARKING

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 FIRE DAMPER ACCEPTANCE TEST

All fire dampers and smoke dampers shall be operated under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Fire dampers equipped with fusible links shall be tested by having the fusible link cut in place. Dynamic fire dampers shall be tested with the air handling and distribution system running. All fire dampers shall be reset with fusible links replaced after acceptance testing.

To ensure optimum operation and performance, the damper must be installed so it is square and free from racking.

3.5 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of room fan-coil units ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 1 day for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 16 hours of normal working time and shall

start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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SECTION 15951A

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SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500 (11989; Rev994) Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 (1995) Code for Electricity Metering

ASME INTERNATIONAL (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F (1991) Interface Between Data Technical Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 142 (1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ST 1 (1988) Specialty Transformers (Except

General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 508 (1993; Rev thru Oct 1997) Industrial Control Equipment

UL 555S (1996) Leakage Rated Dampers for Use in Smoke Control Systems

1.2 GENERAL REQUIREMENTS

The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system.

1.2.1 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

1.2.2 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.5 Surge Protection for Transmitter and Control Wiring

DDC system control-panel equipment shall be protected against surges

induced on control and transmitter wiring installed outside. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An eight microsecond by 20-microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

1.2.6 System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each DDC controller shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

1.2.7 DDC System Network Accessibility

Where the systems to be controlled by the DDC system are located in multiple mechanical rooms, each mechanical room shall have at least one communication port for the portable workstation/tester. DDC controllers shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room.

1.2.8 System Accuracy and Display

The system shall maintain an end-to-end accuracy for one year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.05 degree C.

1.2.8.1 Space Temperature

Space temperature with a range of 10 to 30 degrees C plus or minus 0.5 degrees C for conditioned space; minus 1 to plus 55 degrees C plus or minus 0.5 degrees C for unconditioned space.

1.2.8.2 Duct Temperature

Duct temperature with a range of 5 to 60 degrees C plus or minus 1 degree C.

1.2.8.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 35 to plus 55 degrees C plus or minus 1 degree C; with a subrange of minus 1 to plus 40 degrees C plus or minus 0.5 degree C.

1.2.8.4 Water Temperature

Water temperature with a range of minus 1 to plus 40 degrees C plus or minus 0.5 degree C; the range of 40 to 120 degrees C plus or minus 1

degree C; and water temperatures for the purpose of performing energy calculations using differential temperatures to plus or minus 0.5 degree C using matched sensors.

1.2.8.5 High Temperature

High temperature with a range of 100 to 260 degrees C plus or minus 1 degree C.

1.2.8.6 Relative Humidity

Relative humidity, within a range of 20 to 80 percent, plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

1.2.8.7 Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest kPa.)

1.2.8.8 Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as liters per second).

1.2.8.9 KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

1.2.8.10 Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

HVAC Control System

Drawings shall be on A1 (841 by 594 mm) sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall have a unique identifier as shown. The

HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations must be approved by the Contracting Officer. Drawings shall be submitted along with Submittal SD-01, Data.

a. HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend.

Sheet Two: Valve Schedule, Damper Schedule.

Sheet Four: Control System Schematic and Equipment Schedule.

Sheet Five: Sequence of Operation and Data Terminal Strip Layout.

Sheet Six: Control Loop Wiring Diagrams.

Sheet Seven: Motor Starter and Relay Wiring Diagram.

Sheet Eight: Communication Network and Block Diagram.

Sheet Nine: DDC Panel Installation and Block Diagram.

b. The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The HVAC Control System Legend shall show generic symbols and the name of devices shown on the HVAC Control System Drawings.

c. The valve schedule shall include each valve's unique identifier, size, flow coefficient K_v , pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

d. The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the maximum leakage rate at the operating static-pressure differential. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

e. The HVAC control system schematics shall be in the form

shown, and shall show all control and mechanical devices associated with the HVAC system. A system schematic drawing shall be submitted for each HVAC system.

f. The HVAC control system equipment Schedule shall be in the form shown. All devices shown on the drawings having unique identifiers shall be referenced in the equipment schedule. Information to be included in the equipment schedule shall be the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e., output range). An equipment schedule shall be submitted for each HVAC system.

g. The HVAC control system sequence of operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of operation shall be submitted for each HVAC control system including each type of terminal unit control system.

h. The HVAC control system wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panel board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

SD-03 Product Data

Service Organizations

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

Equipment Compliance Booklet

The HVAC Control System Equipment Compliance Booklet (ECB) shall be in booklet form and indexed, with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers.

Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a Bill of Materials for each HVAC Control System. The Bill of Materials shall function as the Table of Contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB. The ECB shall be submitted along with Submittal SD-04, Drawings.

Commissioning Procedures

Six copies of the HVAC control system commissioning procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal unit control system. The Commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The Commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

a. The Commissioning procedures shall include detailed, product specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

b. An HVAC control system commissioning procedures equipment list shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Performance Verification Test Procedures

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training

An outline for the HVAC control system training course with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training. Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course.

SD-06 Test Reports

Commissioning Report

Six copies of the HVAC Control System Commissioning Report, in booklet form and indexed, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning procedures and shall follow the format of the commissioning procedures. The commissioning report shall include all configuration checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, results of adjustments, and results of testing.

Performance Verification Test

Six copies of the HVAC Control System Performance Verification Test Report, in booklet form and indexed, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of all data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

SD-07 Certificates

Air Storage Tank

An ASME Air Storage Tank Certificate for each storage tank.

SD-10 Operation and Maintenance Data

Operation Manual Maintenance and Repair Manual

Six copies of the HVAC Control System Operation Manual and HVAC Control System Maintenance and Repair Manual, for each HVAC control system, 30 days before the date scheduled for the training course.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the

storage condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 OPERATION MANUAL

An HVAC control system operation manual in indexed booklet form shall be provided for each HVAC control system. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built configuration checksheets, the procedures for changing HVAC control system setpoints, and the procedures for placing HVAC system controllers in the manual control mode.

a. The procedures for changing HVAC control system setpoints shall describe the step-by-step procedures required to change the process variable setpoints, the alarm setpoints, the bias settings, and setpoint reset schedules.

b. The procedures for placing HVAC system controllers in the manual control mode shall describe step-by-step procedures required to obtain manual control of each controlled device and to manually adjust their positions.

1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual in indexed booklet form in hardback binders shall be provided for each HVAC control system. The maintenance and repair manual shall include the routine maintenance checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet.

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment data compliance booklet and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet shall include the equipment compliance booklet and manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

1.7 MAINTENANCE AND SERVICE

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

1.7.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

1.7.2 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.7.3 Scheduled Inspections

Two inspections shall be performed at six-month intervals and all work required shall be performed. Inspections shall be scheduled in six months and one year after system acceptance. These inspections shall include:

- a. Visual checks and operational tests of equipment.
- b. Fan checks and filter changes for control system equipment.
- c. Clean control system equipment including interior and exterior surfaces.
- d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.
- e. Run system software diagnostics and correct diagnosed problems.
- f. Resolve any previous outstanding problems.

1.7.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

1.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within three calendar days after receiving a request for service.

1.7.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.7.7 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.7.8 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

1.7.9 System Modifications

Recommendations for system modification shall be submitted in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.10 Software

Updates to the software shall be provided for system, operating and application software, and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

1.8 FACTORY TESTING

The Contractor shall assemble the factory test DDC system as specified and shall perform test to demonstrate that the performance of the system satisfies the requirements of this specification. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of data produced, including results of each test procedure during factory testing shall be delivered to the Government at the conclusion of testing, prior to Government approval of the test. The test results documentation shall be arranged so that commands, responses, and data acquired are correlated in a manner which will allow for logical interpretation of the data.

1.8.1 Factory Test Setup

The factory test setup shall include the following:

- a. Central workstation/tester.
- b. Printer.
- c. DDC test set.
- d. Portable workstation/tester.
- e. Communication links of each type and speed including MODEMS.
- f. Dial-up MODEM.
- g. Software.

1.9 DDC CONTROL SYSTEM DESCRIPTION

a. The main network server for the DDC system is located in existing Central Plant CP-1, and shall coordinate the transfer of information sent on the Ethernet and Arcnet hubs. The Ethernet hub shall serve as the primary communication backbone for the system, and shall allow for communication on a fiberoptic trunk between existing CP-1, existing CP-2, and future CP-3. The Ethernet hub shall also connect to network routers in COF-9 and future BN-5 due to the long distance between buildings. All other communication signals shall be through the Arcnet hub which shall link through the Ethernet hub via the network routers to the network control panels at each building. The network servers at CP-2 and CP-3 shall be designed to take over control of the system in the event the main network server at CP-1 fails. All other communication signals shall be accomplished through the Arcnet hub which shall link through the Ethernet Hub via the Network Routers to the Network Control Panels at each building.

b. All information on each network control panel shall be accessible and all programming resettable from any of the operator workstations at each of the central plants, or by using a laptop PC link at each Network Control Panel. Each operator workstation shall have a graphic menu to allow review of the current status and for trendlogging of all points on the system using the following hierarchy:

Level 1: Overall site plan showing each building by Building Number.

Level 2. Enlarged plan of each building showing status and location of its individual network router, and listing of all equipment/systems connected to the system.

Level 3: Enlarged schematic graphic of each piece of equipment in the building along with the current status and condition of all monitored points.

c. To the maximum extent possible, all monitoring and active control shall be made at the local universal programmable controller level. Only information that requires exchanging between buildings shall be controlled at the main Network Server.

d. Install DDC control wiring as indicated to connect Bldgs BK-3, BK-4, COF-8, COF-9, COF-10, & COF-11 to existing Central Plants CP-1 & CP-2. DDC control wiring shall be installed in existing or new DDC control wiring duct as indicated on Sheets ES-7, ES-8, & ES-9.

e. Contractor shall be responsible for all work required to tie the new DDC system back into the existing DDC system, so that the combined system is a complete and operational system. Building DDC control systems provided under this contract shall be BACnet compatible at the network control panel level, and shall be compatible with the existing network servers and workstations located in central plants CP-1 and CP-2. Contractor shall be responsible for adding hardware, programming and graphic displays for the existing workstations in central plants CP-1 and CP-2 to accept information from the new buildings constructed in this project.

f. For bidding purposes, site DDC control system shall be split into Bid Item 1 (Phase 2C2) and Bid Item 2 (Phase 2D). Boundaries of Phase 2C2 and Phase 2D are indicated on Sheet CS-2, General Site Plan. DDC control wiring and conduit located within Phase 2C2 boundaries and modifications to existing central plant CP-1 & CP-2 workstations shall be included in Bid Item 1. DDC control wiring and conduit located within phase 2D boundaries shall be included in Bid Item 2.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two years' use shall include applications of equipment and materials under similar circumstances and of similar size. The two years' experience shall be satisfactorily completed

by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of operation.

2.1.1 Electrical and Electronic Devices

Electrical, electronic, and electropneumatic devices not located within a DDC panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC controllers shall be 4-to-20 mA_{dc} signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

2.1.3 Ambient Temperature Limits

DDC panels shall have ambient condition ratings of 1.7 to 49 degrees C and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 37 to plus 66 degrees C. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.1.4 Year 2000 Compliance

All equipment and software shall be Year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if other information technology properly exchanges date/time data with it.

2.2 WIRING

2.2.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.2.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

2.2.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

2.2.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 50 mm lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.2.5 Transformers

Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

2.3 ACTUATORS

Actuators shall be electric or electronic as shown and shall be provided with mounting and connecting hardware. Electric or electronic actuators shall be used for variable air volume (VAV) air terminal units. Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 90 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point. Pneumatic actuators shall be rated for 172 kPa operating pressure except for high-pressure cylinder-type actuators.

2.3.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.3.2 Positive Positioners

Positive positioners are required for pneumatic actuators. Each positive positioner shall be a pneumatic relay with a mechanical feedback mechanism and an adjustable operating range and starting point.

2.4 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 862 kPa working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Kv. Unless otherwise specified, bodies for valves 40 mm and smaller shall be brass or bronze, with threaded or union ends; bodies for 50 mm valves shall have threaded ends; and bodies for valves 50 to 80 mm shall be of brass, bronze or iron. Bodies for valves 65 mm and larger shall be provided with flanged-end connections. Valve Kv shall be within 100 to 125 percent of the Kv shown.

2.4.1 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 29 to plus 121 degrees C. Valves shall have a manual means of operation independent of the actuator. The rated Kv for butterfly valves shall be the value Kv at 70% open (60 degrees open).

2.4.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.4.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.4.4 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

2.4.5 Valves for Chilled-Water, Condenser-Water, and Glycol Service

Internal valve trim shall be bronze except that valve stems may be type 316 stainless steel. Valve Kv shall be within 100 to 125 percent of the Kv shown. Valves 100 mm and larger shall be butterfly.

2.4.6 Valves for Hot-Water and Dual Temperature Service

For hot water service below 122 degrees C and dual-temperature service, internal trim (including seats, seat rings, modulating plugs, and springs)

of valves controlling water hotter than 99 degrees C shall be Type 316 stainless steel. Internal trim for valves controlling water 99 degrees C or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 121 degrees C or 28 degrees C above the system design temperature, whichever is higher. Valves 100 mm and larger shall be butterfly valves.

2.5 DAMPERS

2.5.1 Damper Assembly

A single damper section shall have blades no longer than 1.2 meters and shall be no higher than 1.8 meters. Maximum damper blade width shall be 203 mm. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 13 mm minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 10 Pa at 5.1 m/s in the wide-open position. Frames shall not be less than 50 mm in width. Dampers shall be tested in accordance with AMCA 500.

2.5.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

2.5.3 Damper Types

Dampers shall be parallel-blade type.

2.5.3.1 Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 102 L/s per square meter at 1017 Pa static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 94 degrees C. Dampers shall be rated at not less than 10 m/s air velocity.

2.5.3.2 Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical space ventilation dampers shall be as shown.

Dampers shall not leak in excess of 406 L/s per square meter at 1017 Pa static pressure when closed. Dampers shall be rated at not less than 7.6 m/s air velocity.

2.5.3.3 Smoke Dampers

Smoke-damper and actuator assembly required per NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be rated at not less than 10 m/s air velocity.

2.5.4 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.6 SMOKE DETECTORS

Duct smoke detectors shall be provided in supply air ducts in accordance with NFPA 90A. Detectors shall be connected to the building fire alarm panel for alarm initiation.

2.7 INSTRUMENTATION

2.7.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4 to 20 mAdc:

- a. Conditioned space temperature, from 10 to 30 degrees C .
- b. Duct temperature, from 5 to 60 degrees C .
- c. High-temperature hot-water temperature, from 94 to 260 degrees C .
- d. Chilled-water temperature, from minus 1 to plus 38 degrees C .
- e. Outside-air temperature, from minus 35 to plus 55 degrees C .
- f. Relative humidity, 0 to 100 percent for space and duct high-limit applications.
- g. Differential pressure for VAV supply-duct static pressure from 0 to 500 Pa .
- h. Pitot-tube air-flow measurement station and transmitter, from 0 to 25 Pa for flow velocities of 3.5 to 6 m/s , 0 to 60 Pa for velocities of 3.5 to 9 m/s , or 0 to 125 Pa for velocities of 3.5 to 13 m/s .
- i. Electronic air-flow measurement station and transmitter, from 0.6 to 13 m/s .

2.7.2 Temperature Instruments

2.7.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3- or 4-wire RTD. Each RTD shall be platinum with a tolerance of 0.30 degrees C at 0 degrees C with a temperature coefficient of resistance (TCR) of .00385 ohms/ohm/deg C and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

2.7.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 0.5 degrees C at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

2.7.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a two-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mA_{dc} output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

2.7.3 Relative Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of minus 4 to plus 55 degrees C. It shall be capable of being exposed to a condensing air stream (100 percent RH) with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a two-wire, loop-powered device and shall have an accuracy of plus or minus three percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20 mA_{dc} output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span adjustments.

2.7.4 Electronic Airflow Measurement Stations and Transmitters

2.7.4.1 Stations

Each station shall consist of an array of velocity sensing elements and an air-flow straightener. Air-flow straightener shall be contained in a flanged sheet metal or aluminum casing. The velocity sensing elements shall be of the RTD or thermistor type, producing a temperature compensated output. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published application data of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 20 Pa at an airflow of 10 m/s.

Station construction shall be suitable for operation at airflows of up to 25 m/s over a temperature range of 4 to 49 degrees C, and accuracy shall be plus or minus three percent over a range of 0.6 to 12.5 m/s. In outside air measurement or in low-temperature air delivery applications, the station shall be certified by the manufacturer to be accurate as specified over a temperature range of minus 29 to plus 49 degrees C. In outside air measurement applications, the air flow straightener shall be constructed of 3 mm aluminum honeycomb and the depth of the straightener shall not be less than 40 mm.

2.7.4.2 Transmitters

Each transmitter shall produce a linear, 4-to-20 mAdc, output corresponding to the required velocity pressure measurement. The transmitter shall be a two-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.7.5 Pitot Tube Airflow Measurement Stations and Transmitters

2.7.5.1 Stations

Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the multiple pitot tube type with averaging manifolds. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published installation instructions of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 20 Pa at an airflow of 10 m/s. Station construction shall be suitable for operation at airflows of up to 25 m/s over a temperature range of 4 to 49 degrees C, and accuracy shall be plus or minus three percent over a range of 2.5 to 12.5 m/s. This device will not be used if the required velocity measurement is below 3.5 m/s or for outside airflow measurements.

2.7.5.2 Transmitters

Each transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required velocity pressure measurement. Each transmitter shall have a low range differential pressure sensing element. The transmitter shall be a two-wire, loop powered device. Sensing element accuracy shall be plus or minus one percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement.

2.7.6 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing

element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus two percent of full scale. The transmitter shall be a two-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required pressure measurement.

2.7.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 50 mm lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.7.8 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white.

2.8 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 5 degrees C of the setpoint shown. Thermostats shall be electronic or electric.

2.8.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 3 degrees C. Room thermostats shall be enclosed with separate locking covers (guards).

2.8.2 Microprocessor Based Room Thermostats

Microprocessor based thermostats shall have built-in keypads for scheduling of day and night temperature settings. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all seven days of the week.

The time program shall allow two separate temperature setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 1 degree C. When used for heat pump applications, the thermostat shall have an emergency heat switch.

2.8.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output

signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 2 to 4 degrees C for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.8.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 1500 mm, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 3 to 9 degrees C. Aquastats shall be of the strap on type, with 5 degrees C fixed differential.

2.8.5 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 6000 mm element which shall respond to the coldest 450 mm segment.

2.8.6 Modulating Capillary Thermostats

Each thermostat shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 2 to 4 degrees C for each output.

2.8.7 Fan-Coil Unit Room Thermostats

Fan-coil unit thermostats in personnel living spaces shall be of the low voltage type with locking covers. Electrical rating shall not exceed 2.5 amperes at 30 volts ac. Housing shall be corrosion resisting metal or molded plastic. Transformer and fan relay shall be provided for the proper operation of each thermostatic control system as necessary to suit the design of the control system using the thermostats specified below. Either separate heating thermostats and separate cooling thermostats or dual element heating cooling thermostats may be provided. Motor speed switches shall be provided for three-speed fan control.

2.8.7.1 Cooling Thermostat

Fan-coil cooling thermostats shall be provided with fixed cooling anticipation heater and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set minimum of 25 degrees C. Cooling thermostats shall have an adjustable range of at least 4 degrees above 25 degrees C.

2.9 PRESSURE SWITCHES AND SOLENOID VALVES

2.9.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.9.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 35 Pa at the low end of the range and 85 Pa at the high end of the range.

2.10 INDICATING DEVICES

2.10.1 Thermometers

Mercury shall not be used in thermometers.

2.10.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 230 mm scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.10.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.10.1.3 Nonaveraging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.10.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 90 mm (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.10.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have a range suitable for the application.

2.10.2 Pressure Gauges

Gauges shall be 50 mm (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus three percent of scale range. Gauges shall meet requirements of ASME B40.1.

2.10.2.1 Hydronic System Gauges

Gauges for hydronic system applications shall have ranges and graduations as shown.

2.10.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 90 mm (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus two percent of scale range.

2.11 CONTROL DEVICES AND ACCESSORIES

2.11.1 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2PDT with eight-pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall not be greater than three watts.

2.11.2 Current to Pneumatic (IP) Transducers

The transducers shall be two-wire current-to-pressure transmitters that convert a 4-to-20 mA_{dc} input signal to a 21 to 103 kPa (3 to 15 psig) , or a 103 to 21 kPa (15 to 3 psig) , pneumatic output, with a conversion accuracy of plus or minus two percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.12 L/s.

2.11.3 Joule or Watthour Meters

Joule meters shall be in accordance with ANSI C12.1 and have pulse initiators for remote monitoring of Joule consumption. Pulse initiator shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1.

2.11.4 Joule or Watthour Meters with Demand Register

Meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of Joule consumption and instantaneous demand. Pulse initiators shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1

2.11.5 Joule or Watthour Transducers

Joule transducers shall have an accuracy of plus or minus 0.25 percent for kW and Joule outputs from full lag to full lead power factor. Input ranges for kW and Joule transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4 to 20 mAdc.

2.11.6 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

2.11.7 Power-Line Conditioners (PLC)

Power line conditioners shall be furnished for each DDC panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power-line side. The PLCs shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus one percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus three percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within five cycles, and 95 percent correction shall be accomplished within two cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

2.12 DIRECT DIGITAL CONTROL (DDC) HARDWARE

All functions, constraints, data base parameters, operator developed programs and any other data shall be downloadable from a portable workstation/tester or the central workstation/tester to network control panels, RIU's, universal programmable controllers, and unitary controllers.

Download shall be accomplished through both the primary network and the local DDC portable workstation/tester port.

2.12.1 Network Control Panel

Network control panels shall be microcomputer-based with sufficient memory provided to perform all specified and shown network control panel functions and operations, including spare capacity for all spares and its I/O functions specified. Each network control panel and remote I/O units (RIU) shall have a minimum of 10% of its I/O functions as spare capacity but not

less than 2 of each type used in each. The type of spares shall be in the same proportion as the implemented I/O functions on the panel, but in no case shall there be less than two spare points of each type. The panel I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points shall necessitate only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator using the central workstation/tester or portable workstation/tester. The panel shall contain all necessary I/O functions to connect to field sensors and control panels. I/O function operation shall be fully supervised to detect I/O function failures. Network control panels shall operate in an independent stand-alone mode, which is defined as all network control panel operations performed by the network control panel without any continuing input from other Direct digital controls or portable workstation/tester. The network control panel shall be capable of controlling a mix of at least 32 RIUs, unitary controllers, and universal programmable controllers.

2.12.1.1 Integral Features

The network control panel shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.
- f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.
- g. An intrusion detection device, connected as an alarm.

2.12.1.2 Communication Interfaces

Network control panel shall be compatible for use with existing workstations in Central Plants 1 and 2. The following communication capabilities shall function simultaneously.

- a. Manufacturers Control Network. Manufacturers control network communications interfaces for each data transmission systems (DTS) circuit

between network control panels and RIUs, unitary controllers, and universal programmable controllers, shall be provided. Communication interfaces shall be provided between each network control panel and associated I/O functions. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the network control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. Network control panel workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

c. Primary Network Port. The network control panel shall either have a built in primary network Port or be capable of accepting a primary network port expansion card for future networking to a base wide utility monitoring and control system (UMCS). The primary network port expansion card shall be either Ethernet (IEEE802.3) or ARCNET.

2.12.1.3 Memory and Real Time Clock (RTC) Backup

The network control panel memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.12.1.4 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 2 meters of the network control panel enclosure.

2.12.1.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each network control panel.

2.12.1.6 Failure Mode

Upon failure of the network control panel, either due to failure of the network control panel hardware or of the manufacturers control network, the network control panel shall revert to the failure mode as shown.

a. Manufacturers Control Network Failure: Upon failure of the manufacturers control network, the network control panel shall operate in an independent stand-alone mode.

b. Network Control Panel Hardware Failure: Upon failure of the network control panel hardware, the network control panel shall cease operation and stop communications with other network control panels, RIUs, unitary controllers and universal programmable controllers connected to the affected network control panel. The affected network control panel shall

respond to this failure as specified and shown.

2.12.2 RIU

The RIU shall be functionally a part of the network control panel as specified, but may be remotely located from the network control panel and communicate over a dedicated communication circuit. When remotely located, the I/O functions shall be subject to the same requirements as for the network control panel hardware. RIUs shall be used to connect remote inputs and outputs to a network control panel and shall contain all necessary I/O functions to connect to field sensors and control devices. RIU operation shall be fully supervised by the network control panel to detect failures. Each RIU shall have a minimum of 10 % of its I/O functions as spare capacity. The type of spares shall be in the same proportion as the implemented I/O functions on the RIU, but in no case shall there be less than two spare points of each type. The RIU shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points by others shall require only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator. The RIU shall either report the status of all connected points on each scan, or report the status of all points which have changed state or value since the previous scan.

2.12.2.1 Integral Features

The RIU shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the RIU, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the RIU for further processing.
- f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.
- g. An intrusion detection device, connected as an alarm.

2.12.2.2 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 2 meters of the RIU.

2.12.2.3 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each RIU.

2.12.2.4 Failure Mode

Upon failure of the RIU, either due to failure of the RIU hardware or of the DTS, the RIU shall revert to the failure mode shown.

2.12.3 Universal Programmable Controller (UPC)

The universal programmable controller shall be a microprocessor based controller designed and programmed to control and monitor systems as shown.

Resident programs shall be contained in reprogrammable nonvolatile memory. Each universal programmable controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures. It shall provide for operation as a device connected to the system via the manufacturers control network.

2.12.3.1 Integral Features

The universal programmable controller shall include as a minimum:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. I/O functions
 - (1) 8 DI
 - (2) 4 DO
 - (3) 8 AI
 - (4) 4 AO
 - (5) 1 PA
- f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the universal programmable controller, with

the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

2.12.3.2 Communication Interfaces

The UPC shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the UPC and a network control panels shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the UPC Panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A UPC workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

2.12.3.3 Memory and RTC Backup

The UPC memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.12.3.4 Specific Requirements

Each universal programmable controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring from any DDC controller connected to the same manufacturers control network as the universal programmable controller. This shall be done using a portable workstation/tester connected to a portable workstation/tester port either directly or via modem.

2.12.3.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each enclosure.

2.12.3.6 Failure Mode

Upon failure of the universal programmable controller, it shall revert to the failure mode of operation as shown.

2.12.4 Unitary Controller

The unitary controller shall be a microprocessor based, stand-alone, dedicated purpose controller, communicating with the network control panel, designed and programmed to control air distribution system mixing boxes, terminal units, heat pumps, fan coil units, self-contained DX units or VAV boxes as shown. Each unitary controller shall contain resident programs in nonvolatile memory for each specific application implemented. Each unitary controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures and shall provide for operation as a device connected to the network control panel via the manufacturers control network.

2.12.4.1 Integral Features

The unitary controller shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and power supply.
- d. Manufacturers control network port.
- e. All I/O functions required to implement the requirements as shown.

f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

2.12.4.2 Communication Interfaces

The unitary controller shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the unitary controller and a network control panel shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the unitary control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A unitary controller workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel. For unitary controller applications where the controller is not mounted in an enclosure, such as for fan-coil units or VAV terminal units, a portable conversion device for an RS-232 connection to the portable workstation/tester may be provided.

2.12.4.3 Specific Requirements

Unitary controller components for new air distribution terminal units shall be furnished to the air distribution terminal unit manufacturer for factory mounting and calibration. Existing air distribution terminal units shall be controlled by field installed unitary controllers.

a. Accessibility and Interfaces: Each unitary controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring using a portable workstation/tester connected to the manufacturers control network. They shall also be accessible with a portable workstation/tester connected to the unitary controller portable workstation/tester port.

b. Air Distribution Terminal Unit Controls - Pressure Independent: Controls shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensor, a damper actuator, and an adjustable microprocessor-based controller. The room temperature sensor shall have occupant setpoint adjustment and temperature display, timed override of unoccupied mode, and a communication port. The controller shall operate the damper for cooling and heating and provide control outputs for duct heating coil if applicable. This controller capability shall allow the sequencing of the damper and the heating coil to maintain conditions in the space.

2.12.4.4 Failure Mode

Upon failure of the unitary controller, it shall revert to the failure mode of operation as shown.

2.12.5 I/O Functions

2.12.5.1 DDC Hardware I/O Functions

I/O Functions shall be provided as part of the DDC system and shall be in accordance with the following:

a. The analog input (AI) function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 10 bits plus sign. Signal conditioning shall be provided for each analog input. Analog inputs shall be individually calibrated for zero and span, in hardware or in software. The AI shall incorporate common mode noise

rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 4-to-20 mAdc.

b. The analog output (AO) function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4-to-20 mAdc. D-to-A conversion shall have a minimum resolution of eight bits plus sign. Analog outputs shall be individually calibrated for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided. An individual gradual switch for manual override of each analog output and means of physically securing access to these switches shall be provided. Each AO shall have a three-position switch for selection of the DDC control signal, no control, or a locally generated control signal for connection to the controlled device. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches for pneumatic control outputs shall provide a connection for an externally generated pneumatic signal. All switches shall be either of a key operated design with the same keying system used for other outputs or otherwise suitably protected from unauthorized access.

c. The digital input (DI) function shall accept on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. The digital output (DO) function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to nondamaging levels. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum contact rating shall be one ampere at 24 Vac. Key locked HOA switches shall be provided for manual override of each digital output. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches shall be common keyed.

e. The pulse accumulator function shall have the same characteristics as the DI. In addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DDC system. The pulse accumulator shall accept rates up to 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

f. Signal conditioning for sensors shall be provided as specified.

g. The binary coded decimal (BCD) function: The BCD function shall have the same characteristics as the DI, except that, in addition, a buffer shall be provided to totalize inputs and allow for interrogation by the network control panel. The BCD function shall have 16-channel optically isolated buffered inputs to read four digit numbers. The BCD function shall accumulate inputs at rates up to 10 inputs per second.

2.12.5.2 Failure Mode

Upon failure of the I/O function, including data transmission failure, logic power supply failure, DDC processor malfunction, software failure, interposing relay power failure, or any other failure which prevents stand alone operation of any DDC normally capable of stand alone operation, connected outputs shall be forced to the failure mode shown.

2.12.6 Portable Workstation/Tester

A portable workstation/tester shall be provided and shall be able to connect to any DDC hardware. The portable workstation/tester shall consist of a portable computer with a nominal 10 inch active color matrix liquid crystal display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, an external VGA monitor port, 32 bit microprocessor operating at a minimum of 100 MHZ. The portable workstation/tester shall have, as a minimum, a 1200 MB hard drive, 16 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA type 3 slot, rechargeable battery, battery charger and 120 Vac power supply. It shall include carrying case, extra battery, charger and a compatible network adapter. The workstation/tester shall:

- a. Run DDC diagnostics.
- b. Load all DDC memory resident programs and information, including parameters and constraints.
- c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.
- d. Control any AO or DO.
- e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.
- f. Display database parameters.
- g. Modify database parameters.
- h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.
- i. Disable/enable each DDC.
- j. Perform all workstation functions as specified.

2.12.7 Existing Central Workstation

Existing central workstations are located in Central Plants CP-1 and CP-2.

2.13 DDC SOFTWARE

All DDC software described in this specification shall be furnished as part of the complete DDC System. DDC software shall be compatible for use with existing DDC software in existing workstations in Central Plants CP-1 and CP-2.

2.13.1 Ownership of Proprietary Material

All project developed DDC hardware and software shall become the property of the Government. These include but are not limited to:

- a. Project graphic images.
- b. Record drawings.
- c. Project database.
- d. Job-specific application programming code.
- e. All project documentation.

2.13.2 Operating System

Each DDC shall contain an operating system that controls and schedules that DDC's activities in real time. The DDC shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that DDC. The execution of DDC application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each DDC real time clock shall be automatically synchronized with the network control panel real time clock at least once per day to plus or minus 10 seconds. When the network control panel is connected to a central workstation/tester, the network control panel RTC shall be updated by the central workstation/tester RTC. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown. The operating system shall allow loading of software, data files data entry, and diagnostics from the central workstation/tester both locally through the central workstation/tester port and remotely through a network control panel and the manufacturers control network.

2.13.2.1 Startup

The DDC shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A DDC restart program based on detection of power failure at the DDC shall be included in the DDC software. Upon restoration of power to the DDC, the program shall restart equipment and restore loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the DDC, if the database and application software are no longer resident or if the clock cannot be read, the DDC shall not restart and systems shall remain in the failure mode

indicated until the necessary repairs are made. If the database and application programs are resident, the DDC shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each DDC shall include a unique time delay setting for each control output when system operation is initiated.

2.13.2.2 Operating Mode

Each DDC shall control and monitor functions as specified, independent of communications with other DDC. This software shall perform all DDC functions and DDC resident application programs as specified using data obtained from I/O functions and based upon the DDC real time clock function. When communications circuits between the DDC are operable, the DDC shall obtain real time clock updates and any required global data values transmitted from other network control panels. The DDC software shall execute commands after performing constraints checks in the DDC. Status and analog values, including alarms and other data shall be transmitted from other network control panels when communications circuits are operable. If communications are not available, each DDC shall function in stand-alone mode and operational data, including the latest status and value of each point and results of calculations, normally transmitted from other network control panels shall be stored for later transmission to the network control panel. Storage for the latest 256 values shall be provided at each network control panel. Each DDC shall accept software downloaded from the network control panel. Constraints shall reside at the DDC.

2.13.2.3 Failure Mode

Upon failure for any reason, each DDC shall perform an orderly shutdown and force all DDC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

2.13.3 Functions

The Contractor shall provide software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each network control panel, RIU, unitary controller and universal programmable controller.

- a. Scanning of inputs.
- b. Control of outputs.
- c. Reporting of analog changes outside a selectable differential.
- d. Reporting of unauthorized digital status.
- e. Reporting of alarms automatically to network control panel.
- f. Reporting of I/O status to network control panel upon request.
- g. Maintenance of real time, updated by the network control panel at least once a day.

- h. Communication with the network control panel.
- i. Execution of DDC resident application programs.
- j. Averaging or filtering of AIs.
- k. Constraints checks (prior to command issuance).
- l. Diagnostics.
- m. Portable workstation/tester operation as specified.
- n. Reset of PA by operator based on time and value.

2.13.3.1 Analog Monitoring

The system shall measure and transmit analog values including calculated analog points. An analog change in value is defined as a change exceeding a preset differential value as specified. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. Analog values shall be expressed in proper engineering units with sign. Engineering units conversions shall be provided for each measurement. Each engineering units conversion set shall include range, span, and conversion equation. A vocabulary of engineering unit descriptors shall be provided, using at least three alphanumeric characters to identify information in the system. The system shall support 255 different engineering units.

2.13.3.2 Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points shall be analog or digital points created by calculation from any combination of digital and analog points, or other data having the properties of real points, including alarms, without the associated hardware. Logic (virtual) points shall be defined or calculated and entered into the database by the Contractor. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator. Calculated point values shall be current for use by the system within 10 seconds of the time of any input changes.

2.13.3.3 State Variables

If an analog point represents more than two (up to eight) specific states, each state shall be nameable. For example, a level sensor shall be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.13.3.4 Analog Totalization

Any analog point shall be operator assignable to the totalization program. Up to eight analog values shall be totalized within a selectable time period. At the end of the period, the totals shall be stored. Totalization shall then restart from zero for the next time period. The program shall keep track of the peak and total value measured during the current period and for the previous period. The operator shall be able to set or reset each totalized value individually. The time period shall be able to be operator defined, modified or deleted on-line.

2.13.3.5 Energy Totalization

The system shall calculate the heat energy in Btus, for each energy source consumed by the mechanical systems specified, totalize the calculated Btus, the instantaneous rate in Btus per hour, and store totals in thousands of Btus (MBtu). The Btus calculated shall be totalized for an adjustable time period. The time period shall be defined uniquely for each Btu totalization.

2.13.3.6 Trending

Any analog or calculated point shall be operator assignable to the trend program. Up to eight points shall be sampled at individually assigned intervals, selectable between one minute and two hours. A minimum of the most recent 128 samples of each trended point shall be stored. The sample intervals shall be able to be defined, modified, or deleted on-line.

2.13.4 I/O Point Database/Parameter Definition

Each I/O point shall be defined in a database residing in the DDC. The definition shall include all physical parameters associated with each point. Each point shall be defined and entered into the database by the Contractor, including as applicable:

- a. Name.
- b. Device or sensor type (i.e., sensor, control relay, motors).
- c. Point identification number.
- d. Unit.
- e. Building number.
- f. Area.
- g. Island.
- h. DDC number and channel address.
- i. KW (running).
- j. KW (starting).

- k. Sensor range.
- l. Controller range.
- m. Sensor span.
- n. Controller span.
- o. Engineering units conversion (scale factor).
- p. Setpoint (analog).
- q. High reasonableness value (analog).
- r. Low reasonableness value (analog).
- s. High alarm limit differential (return to normal).
- t. Low alarm limit differential (return to normal).
- u. High alarm limit (analog).
- v. Low alarm limit (analog).
- w. Alarm disable time period upon startup or change of setpoint.
- x. Analog change differential (for reporting).
- y. Alarm class and associated primary message text.
- z. High accumulator limit (pulse).
- aa. Status description.
- bb. Run time target.
- cc. Failure mode as specified and shown.
- dd. Constraints as specified.

2.13.5 Alarm Processing

Each DDC shall have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that DDC.

2.13.5.1 Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by DIs as specified and shown.

2.13.5.2 Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high

and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Analog alarm limits shall be stored in the DDC database. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return into the proper operating range before being annunciated as a return-to-normal-state. All limits and differentials shall be entered on-line by the operator in limits of the measured variable, without interruption or loss of monitoring of the point concerned. The program shall automatically change the high or low limits or both, of any analog point, based on time scheduled operations as specified, allowing for a time interval before the alarm limit becomes effective. In CPA applications, key the limit to a finite deviation traveling with the setpoint. The system shall automatically suppress analog alarm reporting associated with a digital point when that digital point is turned off.

2.13.5.3 Pulse Accumulator Alarms Definition

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or PA input rates that are outside defined limits as specified and shown. PA totalized values shall be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits shall be assigned to each PA point in the system. Limits shall be stored in the DDC database.

2.13.6 Constraints

2.13.6.1 Equipment Constraints Definitions

Each control point in the database shall have DDC resident constraints defined and entered by the Contractor, including as applicable:

- a. Maximum starts (cycles) per hour.
- b. Minimum off time.
- c. Minimum on time.
- d. High limit (value in engineering units).
- e. Low limit (value in engineering units).

2.13.6.2 Constraints Checks

Control devices connected to the system shall have the DDC memory resident constraints checked before each command is issued to insure that no equipment damage will result from improper operation. Each command shall be executed by the DDC only after all constraints checks have been passed. Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each AI. Values outside the reasonableness limits shall be rejected and an alarm message sent to the network control panel or portable workstation/tester. Status changes and analog point values shall be reported to the workstation upon operator request, such as for reports,

alphanumeric displays, graphic displays, and application programs. Each individual point shall be capable of being selectively disabled by the operator from a workstation/tester. Disabling a point shall prohibit monitoring and automatic control of that point.

2.13.7 Diagnostics

Each DDC shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be usable in conjunction with the central workstation/tester and portable workstation/tester. The software shall display messages in English to inform the tester's operator of diagnosed problems.

2.13.8 Control Sequences and Control Loops

Sufficient memory shall be provided to implement the requirements specified and shown for each DDC. Specific functions to be implemented are defined in individual system control sequences and database tables shown in the drawings, and shall include, as applicable, the following:

- a. PI Control: This function shall provide proportional control and proportional plus integral control.
- b. Two Position Control: This function shall provide control for a two state device by comparing a set point against a process variable and an established deadband.
- c. Floating Point Control: This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.
- d. Signal Selection: This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs.
- e. Signal Averaging: This function shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control. The function shall include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control.
- f. Reset Function: This function shall develop an AO based on up to two AIs and one operator specified reset schedule.

2.13.9 Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, insuring that the correct command shall be issued when the time constraint is no longer in effect or report the rejected command. Override commands entered by the operator shall have

higher priority than those emanating from applications programs.

2.15.10 Resident Application Software

The Contractor shall provide resident applications programs to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the systems connected to the DDC system. Application programs shall be resident and shall execute in the DDC, and shall coordinate with each other, to insure that no conflicts or contentions remain unresolved. The Contractor shall coordinate the application programs specified with the equipment and controls operation, and other specified requirements. A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the ON and OFF states, insuring that the correct command shall be issued when the time constraint is no longer in effect or the rejected command shall be reported. Override commands entered by the operator shall have higher priority than those emanating from application programs.

2.13.10 Program Inputs and Outputs

The Contractor shall select the appropriate program inputs listed for each application program to calculate the required program outputs. Where the specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation shall be provided to replace the missing input, thus allowing the application program to operate. AIs to application programs shall have an operator adjustable deadband to preclude short cycling or hunting. Program outputs shall be real analog or digital outputs or logic (virtual) points as required to provide the specified functions. The Contractor shall select the appropriate input and output signals to satisfy the requirements for control of systems as shown.

2.13.11 DDC General Conditions

The Contractor shall provide software required to achieve the sequences of operation, parameters, constraints, and interlocks shown. Application software shall be resident in the DDC in addition to any other required software. In the event of a DDC failure, the controlled equipment shall continue to function in the failure mode shown.

2.13.12 Scheduled Start/Stop Program

This program shall start and stop equipment based on a time of day schedule for each day of the week, and on a holiday schedule. To eliminate power surges, an operator adjustable time delay shall be provided between consecutive start commands.

a. Program Inputs:

- (1) Day of week/holiday.

- (2) Time of day.
- (3) Cooling and heating high-low alarm limits.
- (4) Cooling and heating start-stop schedules.
- (5) Cooling or heating mode of operation.
- (6) Equipment status.
- (7) Equipment constraints.
- (8) Consecutive start time delay.

b. Program Outputs: Start/stop signal.

2.13.13 Optimum Start/Stop Program

This program shall start and stop equipment as specified for the scheduled start/stop program, but shall include a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, and indoor and outdoor air conditions, using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements. An adaptive control algorithm shall be utilized to automatically adjust the constants used in the program.

a. Program Inputs:

- (1) Day of week/holiday.
- (2) Time of day.
- (3) Cooling or heating mode of operation.
- (4) Equipment status.
- (5) Cooling and heating building occupancy schedules.
- (6) Space temperature.
- (7) Building heating constant (operator adjustable and automatically optimized).
- (8) Building cooling constant (operator adjustable and automatically optimized).
- (9) OA temperature.
- (10) Required space temperature at occupancy (heating).
- (11) Required space temperature at occupancy (cooling).

- (12) Equipment constraints.
- (13) Cooling and heating high-low alarm limits.

b. Program Outputs: Start/stop signal.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of source, excluding the general purpose operating systems and utility programs furnished by computer manufacturers and the non-job-specific proprietary code furnished by the system manufacturer, and object modules for software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of software for each DDC panel shall be provided.

3.1.3 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and DDC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the

contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings. Electrical work shall be as specified in Section 16415A ELECTRICAL WORK, INTERIOR and as shown.

3.2 CONTROL SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 Room Instrument Mounting

Room instruments , such as wall mounted thermostats, shall be mounted 1.5 m above the floor unless otherwise shown. Temperature setpoint devices shall be recess mounted.

3.2.3 Freezestats

For each 2 square meters of coil face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

3.2.4 Averaging Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 3 m per square meter of duct cross-sectional area.

3.2.5 Duct Static Pressure Sensing Elements and Transmitters

The duct static pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

3.2.6 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 General Requirements - HVAC Systems

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as

temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

3.3.1.1 Supply Fan Operating

HVAC system outside air, return air, and relief air dampers shall function as described for specific modes of operation. Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open. Cooling coil control valves and cooling coil circulating pumps shall function as described for the specific modes of operation.

3.3.1.2 Supply Fan Not Operating

When an HVAC system is stopped, all interlocked fans shall stop, the outside air and relief air dampers shall close, the return air damper shall open, all stages of direct-expansion cooling shall stop, the system shall pump down if it has a pump down cycle, humidification shall stop, and cooling coil valves for coils located indoors shall close to the coil. Cooling coil valves of units located outdoors shall open to the coil. Heating coil valves shall remain under control.

3.3.2 Single Zone with Hydronic Cooling Coils

3.3.2.1 Supply Fan Control

- a. On Mode - Supply fan shall start, and shall operate continuously.
- b. Off Mode - The fan shall stop.

3.3.2.2 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.2.3 Hydronic Cooling Coil

- a. On Mode - The control valve shall be modulated by the DDC system from the signal of a space temperature sensor.
- b. Off Mode - The DDC system shall close the cooling coil control valve.

3.3.2.4 Emergency Fan Shutdown

Smoke detectors in the supply air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.3 Single Zone Control with Humidity Control (BK-3 & BK-4 AHU's)

3.3.3.1 Supply Fan Control

- a. On Mode - Supply fan shall start, and shall operate continuously.
- b. Off Mode - The fan shall stop.

3.3.3.2 Filter

Differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.3.3 Cooling Coil

- a. On Mode - The chilled water control valve shall be modulated by the DDC System from the signal of a dry air temperature sensor located downstream of the cooling coil. The motorized chilled water control valve shall be modulate to maintain a constant 12.8C (55F) dry air supply temperature.
- b. Off Mode - The DDC system shall close the cooling coil control valve.

3.3.3.4 Humidity Control

- a. On Mode - The electric reheat coil shall be energized by the DOC System from the signal of an outside air temperature sensor. The reheat coil shall be energized only if the outside air temperature is lower than the OA setpoint (70F). When the outside air temperature is lower than 70F, supply air temperature shall be maintained at the SA setpoint (68F) by staging the reheat coils. If supply air temperature cannot be maintained at 68F by the first stage of reheat, the next step or reheat is activated until all reheat steps are activated. The reheat coil is deenergized when outside air temperature exceeds the OA setpoint (70F)
- b. Off Mode - The electric reheat coil shall be deenergized.

3.3.3.5 Emergency Fan Shutdown

Smoke detectors in the supply air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.4 Fan Coil Unit

- a. Unit-mounted or wall-mounted room thermostat shall signal a motorized chilled water control valve in the fan coil unit to maintain room setpoint temperature at 23.9 degrees C (75 degrees F).
- b. In the "Off" Mode, the fan is off and the control valve is closed. In the hand mode ("Low", "Medium", "High"). The fan shall run continuously at the selected speed and control valve shall cycle to meet setpoint, in the "Auto" mode, the fan cycles from off to medium speed and the control valve cycles to meet setpoint.

3.3.5 Fan Coil Unit with Reheat

- a. Unit-mounted room thermostat/humidistat shall signal a motorized chilled water control valve and a reheat coil in the fan coil unit to maintain room setpoint at 23.9 degrees C (75 Degrees F) and 50 percent relative humidity.
- b. In the "Off" mode, the fan is Off and the control valve is closed. In the hand mode ("Low", "Medium", "High"). The fan shall run continuously at the selected speed and the control valve shall cycle to meet setpoint. In the "Auto" mode, the fan cycles from off to medium speed and the control valve to meet setpoint.
- c. The reheat coil shall activate only if room relative humidity exceeds setpoint as sensed by the room humidistat and room air temperature is lower than setpoint. When the room relative humidity exceeds setpoint, the cooling coil valve will open fully and room temperature maintained by the reheat coils. The reheat strategy reverts back to temperature control when the room relative humidity falls below setpoint humidity.

3.4 COMMISSIONING PROCEDURES

3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control system corrections to ensure that the systems function as described in the sequence of operation.

3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirements shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC system (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational mode signal change, DDC system output relay contacts shall be observed to ensure that they function.

3.4.1.2 Weather Dependent Test Procedures

Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC system readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers,

motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC system readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC system readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.5 Averaging Temperature

Averaging temperature sensing element and transmitter-to-DDC system readout calibration accuracy shall be checked every 600 mm along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.2 Fan Coil Unit

The dual-temperature hydronic system shall be set to heating. Each space thermostat temperature setting shall be turned up so that it makes contact and turns the fan coil unit on. It shall be ensured that the fan coil unit fan starts and the valves open to flow through the coils. Each space thermostat temperature setting shall be turned down and it shall be ensured that the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coils. The dual-temperature hydronic system shall be switched to cooling. Each space thermostat temperature setting shall be turned up and it shall be ensured that contact is broken and the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coil. Each space thermostat temperature setting shall be turned down. It shall be ensured that the fan coil unit fans start and the valves open to flow through the coils. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.3 Single Zone with Hydronic Cooling Coils; No Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. The system shall be checked to see that power and main air are available where required, that the outside air damper, relief air damper, and cooling coil valve are closed, and that the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature

sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system display readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and the actuator travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the control system shall be placed in the ventilation delay mode and in the occupied mode, and it shall be verified that supply fan starts. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating coil and cooling coil valves are under control, by simulating a change in the space temperature through an operator entered value. The control system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air, return air, and relief air dampers come under control by simulating a change in the space temperature.

(2) The control system shall be placed in the minimum outside air mode. It shall be verified that the outside air damper opens to minimum position.

(3) An unoccupied mode signal shall be applied, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be set to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(4) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint.

(5) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(6) With the HVAC system running, a smoke detector trip input signal at each detector shall be simulated, and control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false-alarms any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

3.5 BALANCING, COMMISSIONING, AND TESTING

3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the HVAC control system after all air system and hydronic system balancing has been completed, minimum damper positions set and a report has been issued.

3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the Commissioning Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems.

3.5.4 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed.

The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing). The test shall be conducted 24 hours per day, 7 days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment). After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.5.5 Posted and Panel Instructions

Posted and Panel Instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of laminated half-size drawings and shall include the control system schematic, equipment schedule, sequence of operation, wiring diagram, communication network diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a Routine Maintenance Checklist and as-built configuration check sheets. Panel instructions and one copy of the Operation and Maintenance Manuals, previously described herein, shall be placed inside each control panel or permanently affixed, by mechanical means, to a wall near the panel.

3.6 TRAINING

3.6.1 Training Course Requirements

A training course shall be conducted for 5 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 48 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and 6 sets of all other training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.6.2 Training Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

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SECTION 15990A

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SECTION 15990A

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems
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NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Stds	(1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

TAB Procedures

Proposed procedures for TAB, submitted with the TAB Schematic

Drawings and Report Forms.

Calibration

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-07 Certificates

TAB Firm

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard Systems.	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Adjusting Balancing of Environmental
TAB Specialist	TAB Engineer	TAB Supervisor

SIMILAR TERMS

Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.
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1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1or NEBB Procedural Stds, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including building systems commissioning. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible.

The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be

maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995A COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 TESTING, ADJUSTING, AND BALANCING

3.4.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.4.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.4.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.4.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range

specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.4.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.4.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

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SECTION 15995A

COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Commissioning Team

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

Test Procedures

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Test Schedule; G

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

SD-06 Test Reports

Test Reports; G

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

1.2 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including Section 15990A TESTING, ADJUSTING, AND

BALANCING OF HVAC SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Seismic details shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Each checklist shown in appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which

participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Chilled Water Piping

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Piping complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Piping flushed and cleaned.	___	___	X	___	X	___	___	___
d. Strainers cleaned.	___	___	X	___	X	___	___	___
e. Valves installed as required.	___	___	X	___	X	___	___	___
f. Piping insulated as required.	___	___	X	___	X	___	___	___
g. Thermometers and gauges installed as required.	___	___	X	___	X	___	___	___
h. Verify operation of valves.	___	___	X	___	___	___	___	___
i. Air vents installed as specified.	___	___	X	X	X	___	___	___
j. Flexible connectors installed as specified	___	___	X	X	X	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	___	___	X	___	X	___	___	___
b. TAB operation complete.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Ductwork

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Ductwork complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Ductwork leak test complete.	___	___	X	___	X	___	___	___
d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	X	___	X	___	___	___
e. Ductwork insulated as required.	___	___	X	___	X	___	___	___
f. Thermometers and gauges installed as required.	___	___	___	___	___	___	___	___
g. Verify open/closed status of dampers.	___	___	X	___	X	___	___	___
h. Flexible connectors installed as specified	___	___	X	___	X	___	___	___
Testing, Adjusting, and Balancing (TAB)								
i. TAB operation complete.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Fan Coil Unit

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed.	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
a. Chilled water piping properly connected.	___	___	X	X	X	___	___	___
b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Fan Coil Unit

Checklist Item	Q	M	E	T	C	D	O	U
b. TAB results +10%/-0% of L/s shown on drawings								
c. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Exhaust Fan

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to L/s shown on drawings	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - HVAC System Controls

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. As-built shop drawings submitted.	___	___	X	X	___	___	___	___
b. Layout of control panel matches drawings.	___	___	X	X	___	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	X	X	___	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	X	X	___	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___	___	___
h. Shielded wiring used on electronic sensors.	___	___	X	X	___	___	___	___
Main Power and Control Air								
a. 110 volt AC power available to panel.	___	___	___	X	___	___	___	___
Testing, Commissioning, and Balancing								
a. Testing, Commissioning, and Balancing Report submitted.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Single Zone Air Handling Unit

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	__	__	X	X	X	__	__	__
b. Inspection and access doors are operable and sealed.	__	__	X	__	X	__	__	__
c. Casing undamaged.	__	__	X	X	X	__	__	__
d. Insulation undamaged.	__	__	X	X	X	__	__	__
e. Condensate drainage is unobstructed.	__	__	X	X	X	__	__	__
f. Fan belt adjusted.	__	__	X	__	X	__	__	__
g. Any damage to coil fins has been repaired.	__	__	X	__	X	__	__	__
h. Manufacturer's required maintenance clearance provided.	__	__	X	X	X	__	__	__
Electrical								
a. Power available to unit disconnect.	__	__	__	X	X	__	__	__
b. Power available to unit control panel.	__	__	__	X	__	__	__	__
c. Proper motor rotation verified.	__	__	__	__	X	__	__	__
d. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__
e. Power available to electric heating coil.	__	__	__	X	__	__	__	__
Coils								
a. Chilled water piping properly connected.	__	__	X	__	__	__	__	__
b. Chilled water piping pressure tested.	__	__	X	X	X	__	__	__
c. Air vents installed on water coils with shutoff valves as specified.	__	__	X	X	X	__	__	__
d. Any damage to coil fins has been repaired.	__	__	X	__	X	__	__	__
Controls								
a. Control valves/actuators properly installed.	__	__	X	__	__	__	__	__

Pre-commissioning Checklist - Single Zone Air Handling Unit

Checklist Item	Q	M	E	T	C	D	O	U
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB results +10%/-0% L/s shown on drawings.	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

APPENDIX B
FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Single Zone Air Handling Unit

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply fan operating mode is initiated:

- (1) All dampers in normal position. _____
- (2) All valves in normal position. _____
- (3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation.

- (1) Outside air damper at minimum position. _____
- (2) Return air damper open. _____
- (3) Chilled water control valve modulating to maintain space cooling temperature set point. _____

c. Unoccupied mode of operation

- (1) All dampers in normal position. _____

d. Verify safety shut down initiated by smoke detectors. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Single Zone Air Handling Unit

Functional Performance Test Checklist - Fan Coil Units

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils as per specifications including the following:

a. Cooling only fan coils:

- (1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to cooling set point minus 10 degrees and return to cooling set point. _____
- (2) Check blower fan air flow. _____ L/s
Check blower fan air flow.
- (3) Check cooling coil water flow. _____ L/s
Check cooling coil water flow.
- (4) Verify proper operation of cooling water control valve. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

- Contractor's Chief Quality Control Representative _____
- Contractor's Mechanical Representative _____
- Contractor's Electrical Representative _____
- Contractor's Testing, Adjusting and Balancing Representative _____
- Contractor's Controls Representative _____
- Contracting Officer's Representative _____
- Using Agency's Representative _____

Functional Performance Test Checklist - HVAC Controls

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor _____
Manual measurement _____
Panel reading value _____

c. Verify system stability by changing the controller set point as follows:

- (1) Air temperature - 10 degrees F
- (2) Water temperature - 10 degrees F
- (3) Static pressure - 10 percent of set point
- (4) Relative humidity - percent (RH)

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

d. Verify interlock with other HVAC controls.

e. Verify interlock with fire alarm control panel.

f. Verify interlock with EMCS.

g. Change controller set point 10 percent with EMCS and verify correct response.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Functional Performance Test Checklist - HVAC Controls

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contractor's Officer's Representative _____

Using Agency's Representative _____

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16070A

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-- End of Section Table of Contents --

SECTION 16070A

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995; Rev thru Feb 1999) Fluorescent Lighting Fixtures

UL 1571 (1995; Rev thru Feb 1999) Incandescent Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings
Equipment Requirements

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G, RE
Equipment Requirements; G, RE

Copies of the design calculations with the detail drawings.

Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G, RE

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Transformers
Light Fixtures	
Switchboards (Floor Mounted)	

1.3.3 Electrical Systems

All interior electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification.

1.3.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, the AISC LRFP specifications shall be used for the design.

1.3.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 64 mm trade size and smaller. All other interior conduit, shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Transformers

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with Section 09510 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10. Recessed lighting fixtures not over 25 kg in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw

attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with Section 09510 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 100 mm boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANIOUS EQUIPMENT.

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SECTION 16375A

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SECTION 16375A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C37.72	(1987) Manually-Operated, Dead-Front Padmounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating-Current Systems
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C57.12.28	(1999) Switchgear and Transformers - Padmounted Equipment - Enclosure Integrity
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated

ANSI O5.1 (1992) Specifications and Dimensions for
Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings
on Iron and Steel Products

ASTM A 153/A 153M (2001) Zinc Coating (Hot-Dip) on Iron and
Steel Hardware

ASTM A 48M (1994e1) Gray Iron Castings (Metric)

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

ASTM B 3 (1995) Soft or Annealed Copper Wire

ASTM B 496 (1999) Compact Round
Concentric-Lay-Stranded Copper Conductors

ASTM B 8 (1999) Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft

ASTM C 478 (1997) Precast Reinforced Concrete Manhole
Sections

ASTM C 478M (1997) Precast Reinforced Concrete Manhole
Sections (Metric)

ASTM D 1654 (1992) Evaluation of Painted or Coated
Specimens Subjected to Corrosive
Environments

ASTM D 4059 (1996) Analysis of Polychlorinated
Biphenyls in Insulating Liquids by Gas
Chromatography

ASTM D 923 (1997) Sampling Electrical Insulating
Liquids

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5 (1994; CS5a-1995) Cross-Linked
Polyethylene Insulated Shielded Power
Cables Rated 5 Through 46 kV

AEIC CS6 (1996) Ethylene Propylene Rubber Insulated
Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.20.3	(1997) Metal-Enclosed Interrupter Switchgear
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE C37.41	(1994; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests \\$avail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1993) Cable Joints for Use with Extruded

Dielectric Cable Rated 5000 V Through 138
000 V and Cable Joints for Use with
Laminated Dielectric Cable Rated 2500 V
Through 500 000 V

- IEEE Std 48 (1998) Standard Test Procedures and
Requirements for Alternating-Current Cable
Terminations 2.5 kV through 765 kV
- IEEE Std 592 (1990; R 1996) Exposed Semiconducting
Shields on Premolded High Voltage Cable
Joints and Separable Insulated Connectors
- IEEE Std 81 (1983) Guide for Measuring Earth
Resistivity, Ground Impedance, and Earth
Surface Potentials of a Ground System
(Part 1) \\\\$31.00\$\\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA FB 1 (1993) Fittings, Cast Metal Boxes, and
Conduit Bodies for Conduit and Cable
Assemblies
- NEMA LA 1 (1992) Surge Arresters
- NEMA TC 5 (1990) Corrugated Polyolefin Coilable
Plastic Utilities Duct
- NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct
for Underground Installation
- NEMA TC 7 (1990) Smooth-Wall Coilable Polyethylene
Electrical Plastic Duct
- NEMA WC 7 (1988; Rev 3 1996)
Cross-Linked-Thermosetting-Polyethylene-Insulated
Wire and Cable for the Transmission and
Distribution of Electrical Energy
- NEMA WC 8 (1988; Rev 3 1996)
Ethylene-Propylene-Rubber-Insulated Wire
and Cable for the Transmission and
Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

- UL 1072 (1995; Rev Mar 1998) Medium Voltage Power
Cables

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

- a. Altitude 6000 m
- b. Ambient Temperature 25 degrees C

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

- a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
- b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

- a. Medium-voltage cables and accessories including cable installation plan.
- b. Transformers.
- c. Switchgear.
- d. Pad-mounted loadbreak switches.

As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and

changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Fault Current Analysis; G, RE
 Protective Device; G, RE
 Coordination Study; G, RE

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Nameplates

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

General Installation Requirements

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

Cable Installation

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with cable pulls numerically identified.

- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling tensions.
- f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements.

The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Joints

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of

the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of

producing indentations more than 25 mm in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTS AND COATINGS.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072. Cables shall be manufactured for use in duct applications.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation

conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase. The shield tape shall be sized to meet IEEE C2 requirements for a ground fault availability of 14,400 amperes.

2.4.1.6 Neutrals

Neutral conductors shall be copper employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall be of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to

NEMA TC 5 or NEMA TC 7.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592.

Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B.

Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus

terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 315 mm long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.2 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F),

nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 69 MPa (10,000 psi) and a flexural strength of at least 34.5 MPa (5000 psi). Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.8.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, drawout, dry-well-mounted, current-limiting fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one

piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

2.8.1.2 Load-Break Switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

2.8.1.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity.....As indicated.
 Impedance.....5.75%.
 Temperature Rise.....65 degrees C.
 High-voltage winding.....12.47 kV x 7200V volts.
 High-voltage winding connections.....DELTA.
 Low-voltage winding..... As indicated.
 Low-voltage winding connections.....WYE.

2.8.1.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.1.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.8.2 Pad-Mounted Sectionalizers

Pad-mounted, sectionalizing switches shall conform to the requirements of IEEE C37.63. The switchgear shall be configured with 2 incoming compartments for loop-feed arrangement equipped with air-insulated, load-interrupter switches, as indicated. The outgoing compartments shall be provided with non-reclosing sectionalizers.

2.8.2.1 Ratings

Ratings at 60 Hz shall be:

Nominal voltage (kV).....	14.4.
Rated maximum voltage (kV).....	17.
Rated continuous current (A).....	600.
Three-second short-time current-carrying capacity (kA).....	22.4.
BIL (kV).....	95.

2.8.2.2 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of ANSI C57.12.28, ANSI C37.72, and IEEE C37.20.3, Category A.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Fuses, Medium-Voltage, Including Current-Limiting

2.9.1.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.1.2 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.9.2 Transformer Circuit Fuses

Transformer circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the oxide varistor.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 zinc-coated steel conforming to ANSI C135.30 in diameter by 3.1 m (10 feet) in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200a CONCRETE REINFORCEMENT.

2.13 PADLOCKS

Padlocks shall comply with Section 08710 DOOR HARDWARE.

2.14 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.14.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 50 mm (2 inches) wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) thick, conforming to UL 510.

2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

- a. Transformers: Manufacturer's standard routine, design, and other tests in accordance with IEEE C57.12.00.
- b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.
- c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.
- d. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.
- e. Outdoor Switchgear: Manufacturer's standard tests in accordance

with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

- f. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316a EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each

tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm (1/4 inch) less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters (8 cubic inches) of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.

- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inch) diameter, and 900 mm (36 inches) for ducts 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid.

Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 150 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 1.5 m below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm vertically.

3.5.4 Nonencased Direct-Burial

Top of duct lines shall be as indicated. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm. The first 150 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 15 mm above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with

adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 Ground Rods

A ground rod shall be installed at the manholes, telecommunications maintenance holes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 100 mm of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose. Three-phase transformers shall be installed with positive phase sequence.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 100 mm above finished paving or grade and sloped to drain. Edges of concrete pads shall have 20 mm chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be

provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200a CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed alike.

3.8 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m outside of a building and 600 mm below finished grade as specified and provided under Section 16415A ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.9 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, or a switchgear ground bus, to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.9.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods

shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade.

- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 600 mm, plus or minus 75 mm, below finished top of soil grade. Ground ring conductors shall be No. 2 AWG, minimum.
- c. Additional electrodes - When the required ground resistance is not met, additional electrode shall be provided. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.9.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.9.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.9.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.9.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm above and 150 mm

below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.9.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 600 mm of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.9.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm.

3.10 FIELD TESTING

3.10.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.10.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.10.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of

electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Ground ring - 25 ohms.

3.10.4 Ground-Mat Connection Inspection

All below-grade ground-mat connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

3.10.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.10.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304.8 / (\text{length of cable in meters})$$

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.10.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

- a. Insulation resistance test phase-to-ground.
- b. Turns ratio test.
- c. Correct phase sequence.
- d. Correct operation of tap changer.

3.10.8 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.10.9 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

- a. Pad-mounted transformers
- b. Switchboards
- c. Metal-enclosed switchgear

3.10.10 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.11 MANUFACTURER'S FIELD SERVICE

3.11.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.11.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.12 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

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SECTION 16415A

ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps

ANSI C78.2A (1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps **

ANSI C78.2B (1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps **

ANSI C82.1 (1997) Specifications for Fluorescent Lamp Ballasts \ \$18.00\$ \F \X Addenda D & E

ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1 (1995) Hard-Drawn Copper Wire

ASTM B 8 (1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM D 709 (2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13 (1993) Instrument Transformers

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \ \$31.00\$ \F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NEMA ICS 3 (1993) Industrial Control and Systems Factory Built Assemblies

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA LE 4 (1987) Recessed Luminaires, Ceiling Compatibility

NEMA OS 1 (1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA OS 2 (1998) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NEMA PB 1 (1995) Panelboards

NEMA ST 20 (1992) Dry-Type Transformers for General Applications

NEMA VE 1 (1996) Metal Cable Tray Systems

NEMA WD 1 (1999) General Requirements for Wiring Devices

NEMA WD 6 (1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2000) Life Safety Code

NFPA 70 (2002) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 18 Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1 (2000) Flexible Metal Conduit

UL 1029 (1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts

UL 1570 (1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures

UL 1572 (1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures

UL 1660 (2000) Liquid-Tight Flexible Nonmetallic Conduit

UL 20 (1995; Rev thru Oct 1998) General-Use Snap Switches

UL 360 (1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit

UL 467 (1993; Rev thru Apr 1999) Grounding and

Bonding Equipment

UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Jan 1999) Attachment Plugs and Receptacles
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 506	(1994; R Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; Rev thru Dec 1999) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric

Lighting Fixtures for Use in Hazardous
(Classified) Locations

UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 869A	(1998) Reference Standard for Service Equipment
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible.

Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 6.4 mm High Letters	Minimum 3.2 mm High Letters
Panelboards	Control Devices
Starters	Control Devices
Safety Switches	
Transformers	
Equipment Enclosures	
Switchboards	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section 09510 ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission.

Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Transformers.
- b. Switchgear.
- c. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.
- d. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data

Manufacturer's Catalog.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding

resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction.

The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G, RE.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G, RE.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.

- g. A description of adjustments made.

Field Test Plan; G, RE.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G, RE.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.
- h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the

manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

1.5 SEISMIC REQUIREMENTS

Seismic details shall conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Aluminum Conductors

Aluminum conductors shall not be used.

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C)

conductors, provide only conductors with 90-degree C insulation or better.

2.1.4 Bonding Conductor

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter;
ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger
diameter.

2.1.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.2 CABLE TRAYS

Cable tray shall conform to NEMA VE 1, shall form a wireway system, and shall be of depth indicated. Cable trays shall be constructed of zinc-coated steel. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be as shown.

2.2.1 Ladder

Ladder-type cable trays shall be of nominal width as indicated. Rung spacing shall be on 150 mm maximum centers.

2.2.2 Solid Bottom

Solid bottom-type cable trays shall be of a nominal width as indicated. Solid covers shall not be provided.

2.3 CIRCUIT BREAKERS

2.3.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.3.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or

sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.3.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.3.2 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.3.3 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.4 CONDUIT AND TUBING

2.4.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.4.2 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.4.3 Rigid Metal Conduit

UL 6.

2.5 CONDUIT AND DEVICE BOXES AND FITTINGS

2.5.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.5.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.5.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.5.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6 CONNECTORS, WIRE PRESSURE

2.6.1 For Use With Copper Conductors

UL 486A.

2.7 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.7.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 15.9 mm in diameter by 2.4 meter in length of the sectional type driven full length into the earth.

2.7.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.8 ENCLOSURES

NEMA ICS 6 unless otherwise specified.

2.8.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 0.0164 cubic meters shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.8.2 Circuit Breaker Enclosures

UL 489.

2.9 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.9.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

Fluorescent lamps shall be green-tipped and shall have color temperature of 3,000 degrees Kelvin. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
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(1) Linear fluorescent lamps, unless otherwise indicated, shall be 1219 mm long 32 watt T8, 265 mA, with minimum CRI of 86. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts.

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 0 degrees C for twin tube lamps and for double and triple twin tube lamps without internal starter; and -9 degrees C for double and triple twin tube lamps with internal starter.

- c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -29 degrees C. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355, ANSI C78.1375, and ANSI C78.1376.

2.9.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp

manufacturer.

- a. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 25 degrees C above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 25 degrees C above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts as applicable at 60 Hz and maintain constant light output over a line voltage variation of $\pm 10\%$. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 10 degrees C. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum \$10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start	120 or 277 V	1	2.54
	linear & U-tubes		2	1.44
			3	0.93
			4	0.73

- * For ballasts not specifically designed for use with dimming controls.

(3) Dimming fluorescent ballasts shall be electronic and shall comply with the applicable electronic ballast specifications shown above. Dimming ballasts shall be compatible with the specified dimming control equipment and shall operate the lamps shown in the range from full rated light output to 20 percent of full rated light output. Dimming ballasts shall provide smooth square law dimming such that perceived dimming action is proportionate to the motion of the dimming control. Single or two-lamp dimming ballasts shall be used. Multi-lamp dimming ballasts shall be designed to operate lamps of the same length and current rating.

(4) Dimming compact fluorescent ballasts shall be electronic and shall comply with the applicable compact fluorescent and dimming ballast specifications shown above. Ballasts shall operate the lamps shown in the range from full rated light output to 5 percent of full rated light output. Ballast power factor shall be <90% throughout dimming range. THD shall be <10% at maximum light output and <20% at minimum light output. Ballast shall ignite the lamps at any light output setting selected.

- c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 25 degrees C above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of -18 degrees C .

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -29 degrees C .

2.9.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 3 mm . Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

- a. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter,

wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.

- b. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.
- c. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.
- d. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.9.4 Lampholders, Starters, and Starter Holders

UL 542

2.10 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.11 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.11.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.11.2 Motor Starters

Combination starters shall be as indicated.

2.11.3 Thermal-Overload Protection

Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.11.4 Low-Voltage Motor Overload Relays

2.11.4.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70.

2.11.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.11.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is

provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 10 degrees C, an ambient temperature-compensated overload relay shall be provided.

2.12 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.13 RECEPTACLES

2.13.1 Standard Grade

UL 498.

2.13.2 Ground Fault Interrupters

UL 943, Class A or B.

2.13.3 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking: NEMA type 5-15R.

b. 30-Ampere, 125/250 Volt

Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R.

c. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

2.14 Service Entrance Equipment

UL 869A.

2.15 SPLICE, CONDUCTOR

UL 486C.

2.16 SNAP SWITCHES

UL 20.

2.17 TAPES

2.17.1 Plastic Tape

UL 510.

2.17.2 Rubber Tape

UL 510.

2.18 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated.

2.18.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, unventilated. Transformers shall be provided in NEMA 1 enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.19 WATTHOUR METERS, UTILITY REVENUE

Watthour meters shall conform to ANSI C12.1 and ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket-mounted indoor type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.20 INSTRUMENT TRANSFORMERS

2.20.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.20.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.0. Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.20.2.1 Current Transformers for kWh and Demand Metering (Low Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-0.5, with a minimum RF of 2.0 at 30 degrees C, with 600-volt insulation, and 10 kV BIL.

2.20.2.2 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of 0.3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.21 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 1 additional rods not less than 1.8 meters on centers, or if sectional type rods are used, 1 additional section may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be

used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided as indicated. Noncurrent-carrying metal parts of equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit and electrical metallic tubing. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 15 mm. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls.

Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07840a FIRESTOPPING. Raceways shall be kept 150 mm away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 15 meters in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 meters in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200 psi) tensile strength. Not less than 254 mm of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 150 mm above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel. Rigid steel conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.254 mm thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than 25.4 mm from the

reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 3 meters and within 900 mm of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 3 meters.

3.2.1.9 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 15 meters for 15 mm and 20 mm sizes, and 30 meters for 25 mm or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 25 mm (1 inch) size or larger shall not be less than ten times the nominal diameter.

3.2.2 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 1.8 meter intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70.

The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 250 mm from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 103 mm (4 inch) rigid steel conduits with grounding bushings, extending 300 mm beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07840a FIRESTOPPING.

3.2.3 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.3.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 30 meters long and of 277 volts more than 70 meters long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy,

remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.3.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.3.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes.

3.2.3.4 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

- a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

3.2.3.5 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.

Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).

277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).

- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 75 mm of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 1.2 meters above finished floors.

Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 600 mm. The total combined area of all box openings in fire rated walls shall not exceed 0.0645 square meters per 9.3 square meters. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 102 mm square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 2.4 mm wall thickness are acceptable. Large size boxes shall be NEMA 3R or as shown. Boxes in other locations shall be sheet steel. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on

concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 38.1 mm (1-1/2 inches) into reinforced-concrete beams or more than 19.1 mm (3/4 inch) into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 25 mm long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 300 mm long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 6 mm from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 600 mm from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of

the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1.6 mm. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 15 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.2.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.2.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.5.3 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug. Each dryer receptacle shall be furnished with a non-detachable power supply cord for connection to the electric clothes dryer. The cord shall be an angle-type 900 mm length of Type SRD range and dryer cable with three No. 10 AWG conductors.

3.5.4 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range. The cord shall be an angle-type 900 mm length of SRD range and dryer cable with one No. 8 and two No. 6 AWG conductors.

3.5.5 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 or 277 as appropriate volt for use on alternating current only. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings.

3.9 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 1.5 m beyond the building wall and 600 mm below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.10 MOTORS

Each motor shall conform to the kW and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual kilowatt (horsepower) ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.11 MOTOR CONTROL

Each motor requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the

devices used are designed for that purpose and have an adequate kilowatt rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.11.1 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.11.2 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.12 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.13 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated. "T" connections may be used for transformers rated at 15 kVA or below. Dry-type transformers shown located within 1.5 meters of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided

in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.14 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.14.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.14.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.14.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.14.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.14.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 305 by 1219 mm fixtures shall be

mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.14.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straightens so that they hang plumb. Pendants, rods, or chains 1.2 meters or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 3.1 meters or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.14.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.15 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 2 m or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.15.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.15.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.15.3 Food Service Equipment Provided Under Other Sections

Wiring shall be extended to the equipment and terminated.

3.16 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.17 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTS AND COATINGS.

3.18 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.18.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.18.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements.

Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before

the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.

3.18.3 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

$$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304.8 / (\text{length of cable in meters})$$

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.18.3.1 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

3.18.4 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor.

3.18.5 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers.

- a. Insulation resistance test phase-to-ground, each phase.
- b. Turns ratio test.

3.18.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.18.6.1 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual operation of the breaker.

3.18.7 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.19 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.20 FIELD SERVICE

3.20.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.20.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.21 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16528A

EXTERIOR LIGHTING

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SECTION 16528A
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO LTS-3	(1994) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts

ANSI C136.2	(1996) Luminaires, Voltage Classification of Roadway Lighting Equipment
ANSI C136.3	(1995) Roadway Lighting Equipment-Luminaire Attachments
ANSI C136.6	(1997) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting - Socket Support Assemblies for Use in Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1996) Roadway Lighting- Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.11	(1995) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.15	(1997) Roadway Lighting, High Intensity Discharge and Low Pressure Sodium Lamps in Luminaires -

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles
IEEE Std 81	(1983) Guide for Measuring Earth

Resistivity, Ground Impedance, and Earth
Surface Potentials of a Ground System
(Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1998) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 44	(1999) Thermoset-Insulated Wires and Cables
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B	(1997; Rev Jun 1997) Wire Connections for Use with Aluminum Conductors
UL 506	(1994; Rev thru Oct 1997) Specialty Transformers
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1996; Rev Oct 1998) Fittings for Conduit and Outlet Boxes
UL 514C	(1996; Rev thru Dec 1999) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System; G, RE
Detail Drawings; G, RE

Detail drawings for the complete system and for poles, lighting fixtures, bracket arms, handholes, controllers. Detail drawings for precast handholes shall include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes. Drawings shall include design calculations showing adequate strength of screw foundations.

As-Built Drawings

Final as-built drawings shall be finished drawings on mylar or

vellum and shall be delivered with the final test report.

SD-03 Product Data

Equipment and Materials

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

SD-06 Test Reports

CCTV Assessment Lighting; G, RE

Test procedures and reports for CCTV assessment lighting. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Operating Test; G, RE

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements; RE

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

SD-10 Operation and Maintenance Data

Lighting System

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders,

within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.3 SYSTEM DESCRIPTION

1.3.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.3.2 Interface Between Lighting System and Power Distribution

Conductors shall be as indicated.

1.3.3 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.3.4 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.3.5 Unusual Service Conditions

Equipment and materials furnished under this section shall be suitable for the following unusual service conditions: altitude 5,000 m, ambient temperature 80 degrees C.

1.4 CORROSION PROTECTION

1.4.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

1.4.2 Ferrous Metal Materials

1.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.4.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Poles

Poles shall be provided with bracket arms of the support arm style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be provided with insulation of a thickness not less than that the maximum given in TABLE 15.1 of UL 854. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded.

2.4 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.5 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated or aluminized finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm (12 inches) square by 152.4 mm (6 inches) deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.6 HANDHOLES AND PULLBOXES

Handholes and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 69 MPa and a flexural strength of at least 34.5 MPa. Pullbox and handhole covers in parking lots, sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.7 CONDUIT, DUCTS AND FITTINGS

2.7.1 Conduit, Rigid Steel

Rigid steel conduit shall conform to ANSI C80.1 and UL 6.

2.7.2 Conduit Coatings

Underground metallic conduit and fittings shall be coated with a plastic

resin system conforming to NEMA RN 1, Type 40. Epoxy systems may also be used.

2.7.3 Conduit Fittings and Outlets

2.7.3.1 Boxes, Metallic Outlets

NEMA OS 1 and UL 514A.

2.7.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.7.3.3 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.7.3.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.7.3.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7.4 Non-Metallic Duct

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Material of one type shall be used.

Acrylonitrile-butadiene-styrene (ABS) duct shall conform to NEMA TC 6 and NEMA TC 9. High-density conduit shall conform to UL 651A. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75 degree C (167 degrees F) wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.8 GROUND RODS

Ground rods shall be of copper clad steel conforming to UL 467 not less than 15.9 mm (5/8 inch) in diameter by 2.4 m (8 feet) in length of the sectional type driven full length into earth.

2.9 POLES

Metal poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for the maximum wind velocity excepted at the site, at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles

shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.9.1 Aluminum Poles (Area Lighting Poles)

Aluminum poles and brackets for lighting shall have a dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

- a. Shafts shall be as indicated on the drawings. The wall thickness shall be at least 4.8 mm (0.188 in). Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for anchorage.
- b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.9.2 Steel Poles (Roadway Lighting Poles)

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 900 to 1270 mm above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.9.3 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.10 SERIES ROADWAY LIGHTING INSULATORS

Pin insulators shall be Class 55-5. Line-post insulators shall be Class 57-1 or 57-11.

2.11 ELECTRICAL ENCLOSURES

2.11.1 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

2.12 ILLUMINATION

2.12.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for exterior lighting shall be in accordance with the contract documents.

2.12.2 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be in accordance with the contract drawings.

2.13 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.13.1 High-Pressure Sodium

Lamps shall conform to ANSI C78.1350 or ANSI C78.1351 or ANSI C78.1352 or ANSI C78.1355. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

2.13.2 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

2.14 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.15 LIGHTING CONTROL EQUIPMENT

2.15.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 5.4 to 53.8 lux. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.15.2 Timer Control Switches

A time switch as indicated and with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA 3R enclosure conforming to NEMA ICS 6.

2.15.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.15.4 Safety Switches

Switches shall be the heavy-duty type with NEMA ICS 6 Type 1 enclosures and shall be suitable for operation on a 277 or 120 volt, 60 Hz, single-phase system. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. Blades shall be visible with door open and shall be of the quick-make, quick-break type. Terminal lugs shall be coordinated with the wire size. Switches shall conform to UL 98.

2.15.5 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 277 or 208 volts, single phase, 60 Hz. Coil voltage shall be as indicated. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.16 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.17 LUMINAIRES, FLOODLIGHTING

2.17.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572.

2.18 FIXTURES

Standard fixtures shall be as detailed on the contract documents. Special fixtures shall be as indicated on the drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.18.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.18.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

2.18.3 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated as indicated, with insulated boots. Fuse rating shall be as indicated.

2.19 TRANSFORMERS

Transformers shall conform to UL 506. Exterior transformer cases shall be given rust-inhibiting treatment and standard finish by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government. The Contractor shall not take any corrective action without written permission from the Government.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where

connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers (0.010 inch) thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each handhole and junction box, and at each terminal.

3.4.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.4.2 Installation in Duct Lines

Ground and neutral conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.5 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated and shall be properly connected to the indicated equipment. Empty conduits to the indicated equipment from a point 1.5 m outside the building wall and 600 mm below finished grade are specified in Section 16415A ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed to prevent moisture or gases from entering the building.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inches) in diameter, and 900 mm (36 inches) for duct 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m (25 feet) shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70 except that electrical duct bank configurations for ducts 150 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, tops of concrete encasements shall not be less than the cover requirements listed in NFPA 70. Where ducts are jacked under existing pavement, rigid steel conduit shall be installed. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete, and joints shall be staggered at least 150 mm vertically.

3.6.4 Nonencased Direct-Burial

Top of duct lines shall be as indicated on the drawings and shall be installed with a minimum of 75 mm of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm of earth is required. Bottom of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp

objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm. The first 150 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm layers. Duct banks may be held in alignment with earth. However, high tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.6.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved.

3.6.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.6.6 Concrete

Concrete work shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be plain, 17 MPa (2500 psi) at 28 days, except that reinforced concrete shall be 21 MPa (3000 psi) at 28 days. Duct line encasement shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.6.7 Duct Line Warning Tape

A 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.7 HANDHOLES

The exact locations shall be determined after carefully considering the locations of other utilities, grading, and paving. Exact locations shall be approved before construction is started.

3.7.1 Construction

Handholes shall be constructed as indicated on drawings, including appurtenances. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic construction. Concrete shall be 21 MPa at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be

used. In paved areas, the top of entrance covers shall be flush with the finished surface of the paving. In unpaved areas, the top of entrance covers shall be approximately 15 mm above the finished grade. Where finished grades are in cut areas, unmortared brick shall be installed between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. The openings around entering duct lines shall be caulked tight with lead wool or other approved material.

3.7.2 Appurtenances

The following appurtenances shall be provided for each handhole.

3.7.3 Cable Pulling-In Irons

A cable pulling-in iron shall be installed in the wall opposite each duct line entrance.

3.7.4 Ground Rods

In each handhole, at a convenient point close to the wall, a ground rod conforming to paragraph GROUNDING shall be driven into the earth before the floor is poured; approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall.

3.8 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting as indicated on the drawings. Electrical cabling shall be provided to the light pole as specified in Section 16415A ELECTRICAL WORK, INTERIOR. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.8.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.8.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the

foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 21 MPa (3000 psi) at 28 days.

3.8.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 3 m above grade.

3.9 LIGHTING

3.9.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.9.2 Fixture Installation

Standard fixtures shall be installed as detailed on the drawings. Special fixtures shall be as indicated on drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.9.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.9.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.10 LIGHTING CONTROL SYSTEM

3.10.1 Photo-Control

Lighting luminaires shall be individually controlled by photo-control elements mounted on the heads of the luminaires.

3.10.2 Time Control Switches

Switches shall be installed with not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.10.3 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than

four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.10.4 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.11 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm below finished grade, except in handholes.

3.11.1 Ground Rods and Pole Butt Electrodes

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, one additional electrode shall be provided interconnected with grounding conductors, to achieve the specified ground resistance. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.11.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.11.3 Lighting Pole

A minimum of one ground rod shall be provided at each pole. Bases of lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire.

3.11.4 Handhole

In each handhole, at a convenient point close to the wall, a ground rod shall be driven into the earth before the floor is poured, and approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall. Connection to ground rods shall be by means of bolted-clamp terminals or by an approved

fusion-welding process. Ground wires shall be neatly and firmly attached to handhole walls, and the amount of exposed bare wire shall be held to a minimum.

3.12 TESTS

3.12.1 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.12.2 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE Std 81.

The contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

-- End of Section --

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SECTION 16710A

PREMISES DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-568-A-5	(2000) Transmission Performance Specifications for 4-pair 100 ohm Category 6 Cabling
EIA ANSI/TIA/EIA-569-A	(1998) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications
EIA TIA/EIA-TSB-67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-90-661	(2000) Category 3, 5, & 6 Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communications Wiring Systems
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal,

riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

- a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.
- b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.
- c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Premises Distribution System; G, RE.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a

system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; G, RE.

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Record Keeping and Documentation; G, RE.

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606.

Spare Parts.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

Manufacturer's Recommendations; G, RE.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan; G, RE.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; G, RE.

The qualifications of the Manufacturer, Contractor, and the

Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-06 Test Reports

Test Reports.

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 89 mm diskettes in ASCII format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 7 days after completion of testing.

SD-07 Certificates

Premises Distribution System.

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-A, EIA ANSI/TIA/EIA-569-A, and EIA ANSI/TIA/EIA-606 standards.

Materials and Equipment.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; G, RE.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8 RECORD KEEPING AND DOCUMENTATION

1.8.1 Cables

A record of all installed cable shall be provided in hard copy format and on electronic media using Windows based computer cable management software per EIA ANSI/TIA/EIA-606. A licensed copy of the cable management software including documentation, shall be provided. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility per EIA ANSI/TIA/EIA-606.

1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy formant and on electronic media using Windows based computer cable management software per EIA ANSI/TIA/EIA-606. A licensed copy of the cable management software including documentation, shall be provided. The hardware records shall include only the required data fields per EIA ANSI/TIA/EIA-606.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Backbone Cable

Backbone cable shall meet the requirements of ICEA S-90-661 and EIA ANSI/TIA/EIA-568-A for Category 6 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMP per NFPA 70.

2.2.2 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-A-5 for Category 6. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be rated CMG, per NFPA 70.

2.2.3 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the

cable it serves. Hardware shall be in accordance with EIA ANSI/TIA/EIA-568-A.

2.2.3.1 Telecommunications Outlets

Wall and desk outlet plates shall be as indicated on the drawings. Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-A. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be ivory in color, impact resistant plastic. Mounting plates shall be provided for system furniture and shall match the system furniture in color. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as indicated on the drawings. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-A, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-A-5.

2.2.3.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 480 mm (19 inch) rack mounted panels. Jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-A. Jacks shall be unkeyed. Panels shall be provided with labeling space. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-A, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-A-5.

2.2.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per EIA ANSI/TIA/EIA-568-A. Patch cords shall be unkeyed. Patch cords shall be factory assembled. Patch cords shall conform to the requirements of EIA ANSI/TIA/EIA-568-A-5 for Category 6.

2.2.3.4 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-A, and shall be rated for use with Category 5e cable in accordance with EIA ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-A-5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors

shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 EQUIPMENT RACKS

2.3.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 480 mm (19 inches). Uprights shall be 75 mm deep channel, 32 mm wide, drilled and tapped 12-24 in a 13 mm pattern. Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 2.1 m in height and coated painted. AC outlets shall be provided as shown.

2.3.2 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 480 mm (19 inch) equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.4 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

2.5 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 117 mm square by 53 mm deep with minimum 9 mm deep single or two gang plaster ring as shown. Provide a minimum 25 mm conduit.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840a FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-A and as specified in Section 16415A ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall

comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 200 mm above ceilings by cable supports no greater than 1.5 m apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm (12 inches) shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 1.8 meters long shall be neatly coiled not less than 300 mm in diameter below each feed point in raised floor areas.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 150 mm of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.1.6 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.7 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607 and Section 16415A ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.

- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 Patch cords of 3 m for each telecommunications closet.
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606.

3.5.1.2 Cable

All cables will be labeled using color labels on both ends with unencoded identifiers per EIA ANSI/TIA/EIA-606.

3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels with unencoded identifiers per EIA ANSI/TIA/EIA-606.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

3.6.2 Category 6 Circuits

All category 5e circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TIA/EIA-TSB-67 standard, including the additional tests and test set accuracy requirements of EIA ANSI/TIA/EIA-568-A-5. Testing shall use the Basic Link Test procedure of

EIA TIA/EIA-TSB-67, as supplemented by EIA ANSI/TIA/EIA-568-A-5.. Cables and connecting hardware which contain failed circuits shall be replaced and retested to verify the standard is met.

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SECTION 16711A

TELEPHONE SYSTEM, OUTSIDE PLANT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239 (1999) Polyethylene (PE) Plastic Pipe
(SIDR-PR) Based on Controlled Inside
Diameter

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS REA Bull 345-151 (1989) Conduit and Manhole Construction,
REA Form 515c

RUS Bull 1751F-643 (1998) Underground Plant Design

1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all conduit, manholes, etc. required to provide cable pathways from the closest point of presence to the new facility. The work consists of furnishing, installing, testing and making operational a complete outside plant pathway system for continuous use.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telephone System
Installation

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature.

SD-03 Product Data

Spare Parts
Equipment

A data list of recommended spare parts and tools for each different item of material and equipment specified prior to beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Installation

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

SD-07 Certificates

Telephone System

Proof that the items furnished under this section conform to the specified requirements in FCC, ICEA, REA, RUS, ANSI, ASTM, NFPA, EIA, or UL, where materials and equipment are so specified.

Qualifications

The qualifications of the manufacturer, splicer, and installation supervisor as specified.

1.4 QUALIFICATIONS

1.4.1 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

1.5 DELIVERY AND STORAGE

1.5.1 Equipment

All equipment shall be stored with protection from the weather, humidity

and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

2.2 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS Bull 1751F-643.

2.2.1 New Maintenance Holes

New maintenance holes shall be equipped with pulling-in irons, cable racks, and ground rod, and conform to the requirements of RUS REA Bull 345-151. Maintenance holes shall be as shown.

2.2.2 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415A ELECTRICAL WORK, INTERIOR and 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

2.2.3 Innerduct

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

2.3 MISCELLANEOUS ITEMS

2.3.1 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 150 mm wide with a minimum strength of 12.1 MPa lengthwise and 10.3 MPa crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 1 m deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1.2 m intervals.

PART 3 EXECUTION

3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

3.1.1 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375AELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners.

3.1.1.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 50 mm exposed.

3.1.1.2 Pull Cord

Pull cords of 10 mm, pull cords shall be muletape or approved equal shall be installed in all unused ducts and inner-ducts with a minimum of 610 mm spare cord protruding from each end.

3.2 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

3.2.1 Telecommunication Maintenance Holess

The shields of all cables in each maintenance hole shall be bonded together by a bonding wire or ribbon. At intermediate maintenance holes, where the cable is pulled through without a sheath opening, bonds are not required. If the maintenance hole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

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SECTION 16815A

CABLE TELEVISION PREMISES DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(1999) National Electrical Code

1.2 SYSTEM DESCRIPTION

The cable television premises distribution system shall consist of coaxial cables and connecting hardware to transport television signals throughout the building to user locations as indicated.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, non-condensing.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cable Television Premises Distribution System

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack and panel details, elevation drawings of telecommunications closet walls, outlet face plate details for each outlet configuration, and descriptions and types of cables, conduits, and cable trays, if used. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment

relationship to other parts of the work including clearance for maintenance and operation.

Installation

Record drawings for the installed cable system. The drawings shall show the locations of cable terminations, including outlets, and location and routing of cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Spare Parts.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

Manufacturer's Recommendations

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be provided prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 7 days prior to the proposed test date. The test plan must be approved before testing begins. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications

Proof of the qualifications of the Contractor, Installers, and Manufacturers that will perform the work, and provide the specified products.

SD-06 Test Reports

Testing

Test reports in booklet form with witness signatures verifying execution of tests shall be provided. The cable system testing documentation shall include the physical routing and a test report for each cable (end-to-end) from the installed outlet to the main

termination point. Test reports shall be submitted within 14 days after completion of testing.

SD-07 Certificates

Materials and Equipment

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, is acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Commercial, off-the-shelf manuals for operation, installation, configuration, and maintenance of products provided as a part of the cable television premises distribution system. Specification sheets for cable, connectors, and other equipment shall be provided.

1.5 QUALIFICATIONS

1.5.1 Minimum Contractor Qualifications

Work under this section shall be performed, and equipment shall be furnished and installed, by a qualified Contractor as defined herein. The Contractor shall have a minimum of two years of experience in the installation and testing of coaxial cable-based TV distribution systems and equipment. Installers assigned to the installation of this system or its components shall have a minimum of two years of experience in the installation of the specified coaxial cable and components.

1.5.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract shall be products of manufacturers that have a minimum of two years of experience in producing the types of systems and equipment specified.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least one year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.1.1 COAXIAL CABLE

Coaxial cable shall be RG-6/U, quad shield. Cable shall be label-verified.

Cable jacket shall be factory marked at regular intervals identifying cable type. Cable shall be rated CMG per NFPA 70. Interconnecting cables shall be cable assemblies consisting of RG-6/U coaxial cable with male connectors at each end, provided in lengths determined by equipment locations as shown.

2.1.2 Outlets

Cable television outlets, including wall outlet plates, shall be equipped with a female connector to accept the connecting coaxial cable from the user's television set. Faceplates provided shall be ivory impact resistant plastic.

2.1.3 OUTLET BOXES

Electrical boxes for cable television outlets shall be 117 mm square by 53 mm deep with minimum 9 mm deep single or two gang plaster ring as shown. Conduits shall be minimum 25 mm .

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete cable television distribution system, ready to connect to external television signal sources, shall be provided. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840a FIRESTOPPING. Conduits, outlets, raceways, and wiring shall be installed in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Cables and outlets shall be individually labeled and marked. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Cable Installation

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not

be spliced. Cable not in a wireway shall be suspended a minimum of 200 mm above ceilings by cable supports no greater than 1.5 m apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm shall be maintained when such placement cannot be avoided. Cables shall be terminated unless shown otherwise. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 1.8 m long shall be neatly coiled not less than 300 mm in diameter below each feed point in raised floor areas.

3.1.2 Riser Cable Installation

The rated cable pulling tension shall not be exceeded. Riser cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Outlets

3.1.3.1 Faceplates

Each faceplate shall be labeled with its function and a unique number to identify the cable run.

3.1.3.2 Cables

Cables shall have a minimum of 150 mm of slack cable loosely coiled into the cable television outlet boxes. Minimum manufacturer's bend radius shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in conduits serving the cable television premises distribution system which do not initially have cable installed.

3.2 TERMINATIONS

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. Coaxial cables shall be terminated with appropriate connectors as required. Cable shield conductor shall be grounded to communications ground at only one point and shall not make electrical contact with ground anywhere else.

3.3 GROUNDING

The cable television distribution system ground shall be installed in the cable television entrance facility and in any auxiliary closet identified in Section 16415A ELECTRICAL WORK, INTERIOR or otherwise indicated.

Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup:

- a. 10 of each type of connector used.
- b. 10 of each type of cover plate, with connector.

3.5 LABELING

Cables shall be labeled on both ends with circuit number, room number, or other appropriate marking allowing for correct identification of the cable and its destination.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. Components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the cable television premises distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. After installation of the cable and before connecting system components, each cable section shall be end-to-end tested using a time domain reflectometer (TDR) to determine shorts, opens, kinks, and other impedance discontinuities and their locations. Cable sections showing adverse impedance discontinuities (greater than 6 dB loss) shall be replaced at the Contractor's expense. There shall be no cable splices between system components unless approved by the Government.

-- End of Section --